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Oak cooperage and barrel alternatives are featured in the Supplier Showcase. Photo by Fred Lyon.

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Cover: 70hl French oak tanks (from Tonnellerie Radoux) for red wine fermentation at Vineyard 29 (St. Helena, CA). Photo by Don Neel.

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The compound bud (CB) above the leaf scar (LS) at each cane node consists of a primary bud flanked by two secondary buds.

What causes a BUD to produce a BUNCH OR NOT?

BY Devin Carroll,
Advanced Agricultural Services, Inc.
Hanford, CA

Grape fruitfulness is defined as the percentage of buds that produce one or more flower clusters per shoot. Fruitfulness is determined within developing buds during the year prior to a crop. First, primordial clusters, called inflorescences, either do or do not initiate in each bud. Later, the fruitful buds may be lost through plant-mediated necrosis or from various injurious processes.

Fruitfulness may be estimated prior to pruning by inspection of a sample of buds, allowing a grower to optimize fruit load by leaving the best combination of spur length and spur or cane numbers.

The path to fruitfulness may be visualized as a series of processes beginning at bud break the year of bud formation and ending at bud break the following year when the buds sprout and produce flower clusters:

Inflorescence initiation — Formation of flower clusters begins within each developing bud when certain tissues begin to form either an inflorescence primordia or a tiny tendril. This occurs early in the spring, when the bud is only a few nodes away from the growing tip.

Plant-mediated necrosis — Some time after inflorescence initiation in some buds, the inner section dies above an apparent abscission layer. This is clearly a physiological process initiated by the plant. The plant "decides" that a bud is not worth the metabolic cost, and "tells" the bud to die. Secondary buds on either side of the primary bud usually survive. This kind of necrosis seems to peak in the first couple of months following bloom.

Injury-related necrosis — Injurious environmental factors such as pathogens, heat, water stress or frost might damage a bud and cause it to eventually die.

Bud mites — A strain of the Erineum mite, *Colomerus vitis*, grape bud mites infest only buds. These tiny worm-shaped mites move from old to new buds during the first couple of weeks after bud break, and multiply all year. During inspection in the following winter, we may find hundreds in a bud, where they can damage or destroy the inflorescences.

Inflorescence Initiation

The "bud" which occurs at each node on a cane is actually a compound bud typically composed of three simple buds: a primary bud in the middle and a secondary bud on each side. For most varieties, under California conditions, the primary bud may have up to three flower clusters, or inflorescences, but more typically there are two. Thompson Seedless buds usually have one inflorescence, sometimes two.

The secondary buds often have no inflorescence, but sometimes have one or rarely two; these being smaller than those in the primary bud. Inside each of the three buds is a 6- to 12-node compressed shoot with primordial leaves, flower clusters and tendrils. Buds that push at bud break become shoots.[1,3,4]

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Sometimes two complete compound buds develop at the same node, approximately equal in size and parallel with each other and the direction of shoot growth. This has been noted most commonly in Pinot Noir, but also in Cabernet Sauvignon, Syrah, Merlot, and occasionally Chardonnay.[2]

The compound buds develop sequentially as the cane grows. Each compound bud develops over a two- to three-month period that starts soon after its node first appears at the tip of the growing shoot. The bud then stops growing and remains dormant until bud break the following spring.

A primary bud with one medium-sized inflorescence that will grow into a bunch.

Most of the branching of the rachis occurs in the flower cluster primordia before the buds go dormant in summer, but the flower initials, which become the actual flowers along the rachis, form after winter around bud break. This means that conditions at bud break influence the final number of flowers formed. Otherwise the size of the flower cluster at bud break is determined the prior year.[1,3,4]

Each flower cluster primordium develops from a tiny lump of tissue called an "anlage." Each anlage develops into either an inflorescence (flower cluster) or a tendril. The inflorescence can be distinguished microscopically when the bud is about 10 nodes from the tip of the growing shoot, but the vine's "decision" to form an inflorescence comes much earlier. For example, the correlation of temperature with inflorescence formation is strongest in the third visible node from the apex, which has a leaf of only about 1.5 cm. in diameter.[1,3,4]

In other words, bud fruitfulness in the first few buds is determined by vine physiology and the environment of the shoot in the first weeks following bud break. All of the two to five buds that will constitute next year's spurs differentiate before bloom. In spur-pruned vines, this is next year's entire crop. For cane-pruned varieties, next year's crop will include buds that differentiate further out on the cane, so they pass through the critical environmental conditions at a later time. In Thompson Seedless, differentiation in the first 15 nodes is determined by around the middle of June.[4]

Several factors influence inflorescence differentiation. Some of these

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factors are well-documented; others are merely suggested by the evidence.

Temperature — Both cold and hot temperatures inhibit inflorescence, but in the weeks following bud break, cold temperatures are a threat.

In Muscat grapes, no flower clusters were formed on vines in growth chambers kept at or below a constant 20°C (68°F). The maximum percentage of fruitful buds was at close to 35°C (95°F), and the number declined steeply above that temperature. Different varieties respond at higher or lower temperatures, but the general pattern is the same.[1]

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Some Australian studies suggest that the critical factor is the number of days with maximum temperatures between 82° and 90°F during key time periods, corresponding roughly to the second through fourth weeks of May for Thompson Seedless in the San Joaquin Valley.[4]

Cold spring temperatures are probably the factor most commonly causing area-wide low fruitfulness the following year.

Light and shading — More buds in a shoot produce flower clusters when more light falls on leaves of that shoot. Light on the leaves is more important than previously thought than light on the buds. This seems to be more a function of total accumulated light rather than a peak of maximum intensity. In other words, a shorter day-length or several hours or days of cloudiness could reduce fruitfulness. The Australian study noted above rated solar radiation along with days of favorable temperature as the two critical climatic factors.[4] Shade produced by heavy foliage also reduces bud fruitfulness, but this is not occurring in the first few weeks of growth.[1]

Temperatures are typically cool during cloudy periods, and the two factors in combination can be expected to reduce fruitfulness more than either alone.

Carbohydrate reserves — Stored carbohydrates are thought to have a strong influence on the differentiation of inflorescences in young buds.[2] Carbohydrates are stored in the roots, trunk, cordons, and canes or spurs. These carbohydrates were stored the year before bud differentiation — two years before the crop. This means that growing conditions and vine strength two years ago have a strong influence on this year's fruitfulness.

Buds seem to be a weak carbohydrate sink compared to the growing shoot.[2] Rapid shoot growth can be expected to draw carbohydrates away from the buds, reducing their fruitfulness. Indeed, vigorous vines tend to have lower fruitfulness, but this is also partly due to shading.

Water — Too much water decreases inflorescence; water deficit does not.[4] The affect of over-watering is thought to be indirect; water encourages excessive canopy growth, which shades the

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canes and draws carbohydrates away from the buds. Irrigation maintaining between 60% and 80% of full ET maximized bud fruitfulness.[4]

Nitrogen — Nitrogen deficiency reduces fruitfulness.[2] On the other hand, too much nitrogen causes rapid shoot growth, which will pull carbohydrates away from the buds and reduce their fruitfulness.

Mineral deficiencies — There is some evidence that lack of phosphorus or potassium reduces bud fruitfulness.[2] Low phosphorus around bud break is sometimes caused by cold soil that prevents uptake by the roots, even if the soil has enough of the mineral. Potassium or phosphorus can be added by foliar sprays. The applications would need to be shortly after bud break to increase fruitfulness in the first several buds. No experiments have yet been performed to test this idea.

Plant growth regulator compounds — Plants regulate inflorescence by the interaction of gibberellic acid (GA) and cytokinins.[4] At an early stage, GA increases inflorescence by favoring formation of anlage. But later, GA decreases inflorescence by favoring the alternative path to tendril formation.[2,4] Cytokinins increase inflorescence by favoring inflorescence over tendrils. They also regulated flower differentiation just before budbreak.[4]

Cytokinins are produced naturally in the plant, and they can be augmented with kelp sprays. It might be worthwhile to experiment with kelp in blocks with low fruitfulness, or in years with cold spring weather. Kelp has not been proven to contain the correct cytokinins for grapes; more research is needed.

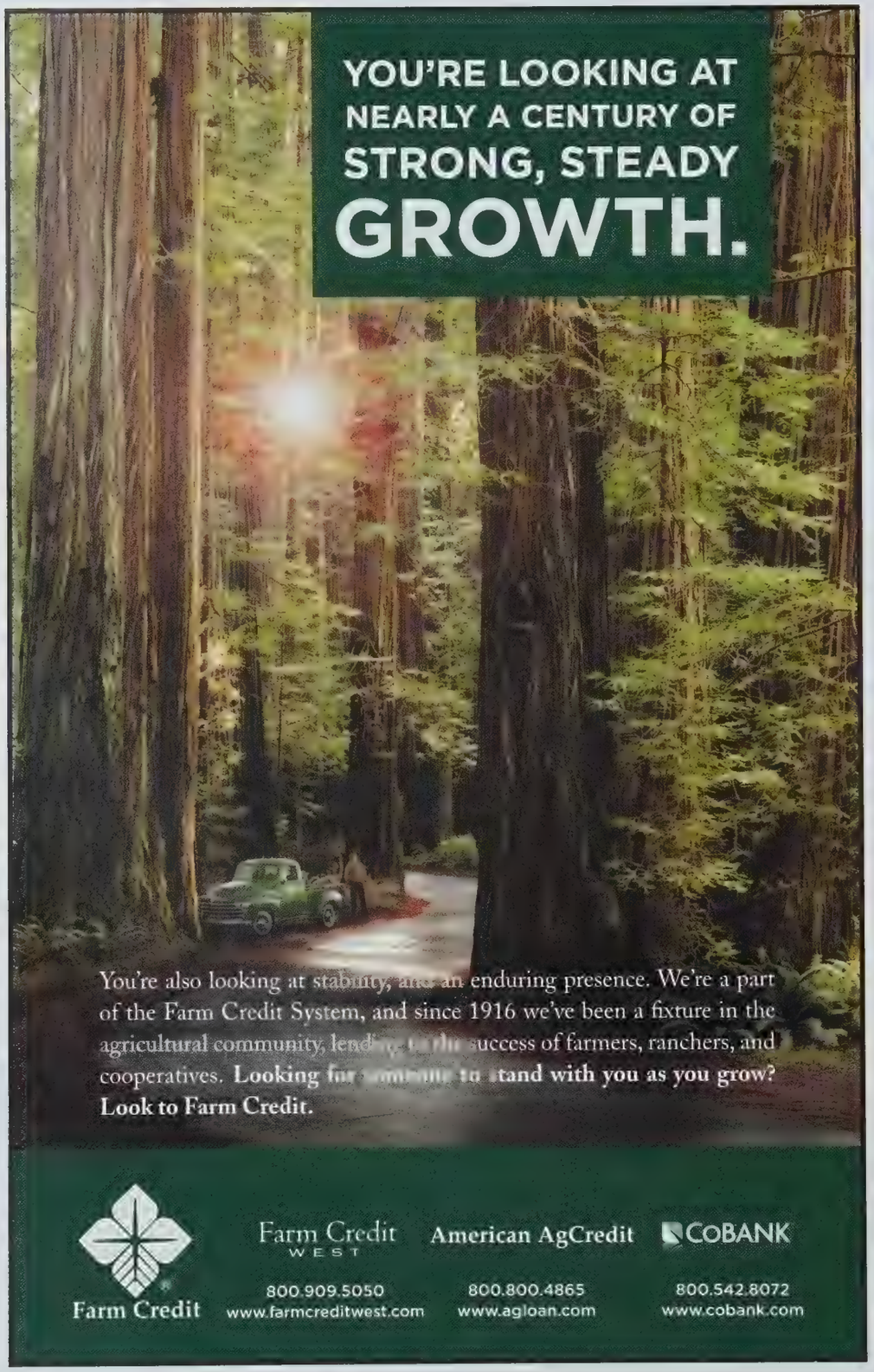
Adding too much gibberellin can reduce inflorescences,[2] but gibberellin is not normally applied soon after bud break. It is more important during the necrosis period, after bloom.

Plant-mediated Bud Necrosis

After the anlage differentiates into either a flower cluster primodia or a tendril, the bud must survive until bud break in the following year to be of any use. Depending on conditions in the vine and the environment, the vine may sacrifice a number of buds to "bud necrosis" or death.

In plant-mediated bud necrosis (PMBN), the middle section of the primary bud dies above an apparent abscission layer. Presumably the necrosis is initiated by some plant hormone. The dead section rather quickly turns into brown fluff that breaks away from the bud when pushed. The two secondary buds usually survive. This kind of necrosis is often called primary bud necrosis (PBN), but injury can also cause necrosis of primary buds (see photo, page 13).

The few studies investigating PMBN indicate that it usually occurs during the first one or two months fol-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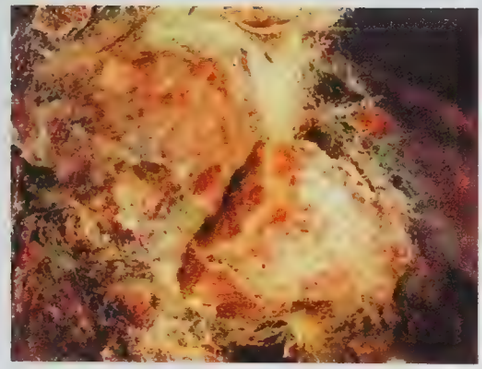

Plant-mediated bud necrosis. The primary bud is dead above an abscission layer.

lowing bloom. During this time, carbohydrates are flowing preferentially to the current season's flower clusters and young berries, leaving less for the developing buds.

Carbohydrate shortage, shading, shoot vigor, and excessive gibberellin have been shown to promote PMBN.

Low carbohydrates — Many studies point to the role of a low level of carbohydrates in PMBN. Buds with lower carbohydrate levels are more likely to die. More vigorous shoots tend to have less carbohydrates and more necrosis than weaker shoots. Grape varieties that tend to have more carbohydrates also tend to be more resistant to PMBN.[5,6]

A study in Virginia found more PMBN in several varieties with low carbohydrates (Riesling, Syrah, and Viognier) than in one with high carbohydrates (Chardonnay).[6]

By the time PMBN starts, after bloom, the carbohydrate contribution of the leaves is presumably more important than reserves in the wood and roots. In a healthy vine, the leaves will be supplying new reserves, in addition to growing the current year's fruit, and maintaining next year's buds.

In times of carbohydrate shortage, buds seem to be a low plant priority, and PMBN can be expected to increase. For example, vineyards that are heavily cropped one year often show reduced fruitfulness the following year. Berry growth pulls carbohydrates away from the buds, and the plant may respond by sacrificing buds through PMBN. Indeed, the period of most rapid berry growth seems to coincide with the majority of PMBN.

Conditions that reduce available carbohydrates, including shading and excessive shoot vigor, also increase PMBN.

Shoot vigor — Excessive vegetative growth in fast-growing canes soaks up carbohydrates, so they are not available to the buds. Several studies have found more PMBN in more vigorous shoots (thicker and with longer internodes), but the correlation is not strong and has not been found in all studies.[5]

Vigorous shoots tend to have lower carbohydrate levels, because the carbohydrates are flowing to new growth. Vegetation also increases shading, another factor that increases PMBN.

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Farming practices that discourage excessive growth might improve fruitfulness. However, if these same practices decrease carbohydrate production, the net effect on fruitfulness might be zero or negative.

Cutting canes of Riesling vines increased PMBN, but only in the buds close to the cut. The shoots were tipped 40 days after bud break at approximately 18 nodes. PMBN increased in buds 13 to 20. The PMBN was attributed to growth of lateral shoots which competed for carbohydrates.[5]

Shading — Shading is an important contributor to PMBN.[5] During the summer months, shading is typically from vegetative growth. Buds in the inner, darker parts of vines, under heavy foliage, are more likely to suffer PMBN than those in better-exposed parts.

Unfortunately, the inside buds include most of those that will be selected by pruning for the following year. Leafing, hedging, and summer pruning will increase light into the canopy and might reduce PMBN.

Several studies have found that shoot thinning decreased PMBN, which was attributed to less shading. One study found the opposite: more PMBN after thinning. This was possibly due to increased vigor of the remaining shoots.[5]

Some studies indicate that only long periods of shade increase PMBN (40 days compared to less than 21). If this is true, then clouds are not likely to be important in California, where long periods of cloudy weather are unknown during summer months.[5]

In Virginia, up to twice as much more PMBN occurs in rainy years. Researchers attributed this partly to shading by clouds and partly to more vigorous vegetative growth draining away carbohydrates.

Plant Growth Regulator (PGR) compounds — Presumably, PMBN is mediated by PGRs that respond to the physiology of the plant and the environment, by signaling certain buds to begin necrosis. The precise mechanism is not known.

Too much gibberellin can increase PMBN, although not all studies have found a correlation. Gibberellin applied early (bloom time) has a stronger effect than when applied later (sizing sprays), and more distal buds are affected more than those near the base.[5]

Several growth retardants can decrease PMBN. Some of these growth retardants act by blocking gibberellin activity, leading some researchers to conclude that gibberellin is the principle PGR signaling buds to die.[5]

The effect of cytokinins on PMBN is not known. However, some limited observations suggest that post-bloom kelp sprays, which have cytokinins, can increase fruitfulness in Thompsons the following year. The post-bloom period is when PMBN occurs, so the cytokinins may be reducing PMBN. This period is probably too late for the cytokinins to be influencing inflorescence.

Water — Too much water has been shown to increase PMBN. This is attributed to extra vegetative growth using up carbohydrates. I have not found any studies linking PMBN to water deficit.

Temperature — I have not found any studies linking PMBN to high or low temperatures. Very low temperatures are not likely to occur in the May-June period when most PMBN occurs. High temperatures could possibly cause injury-related bud necrosis (see photo, page 16).

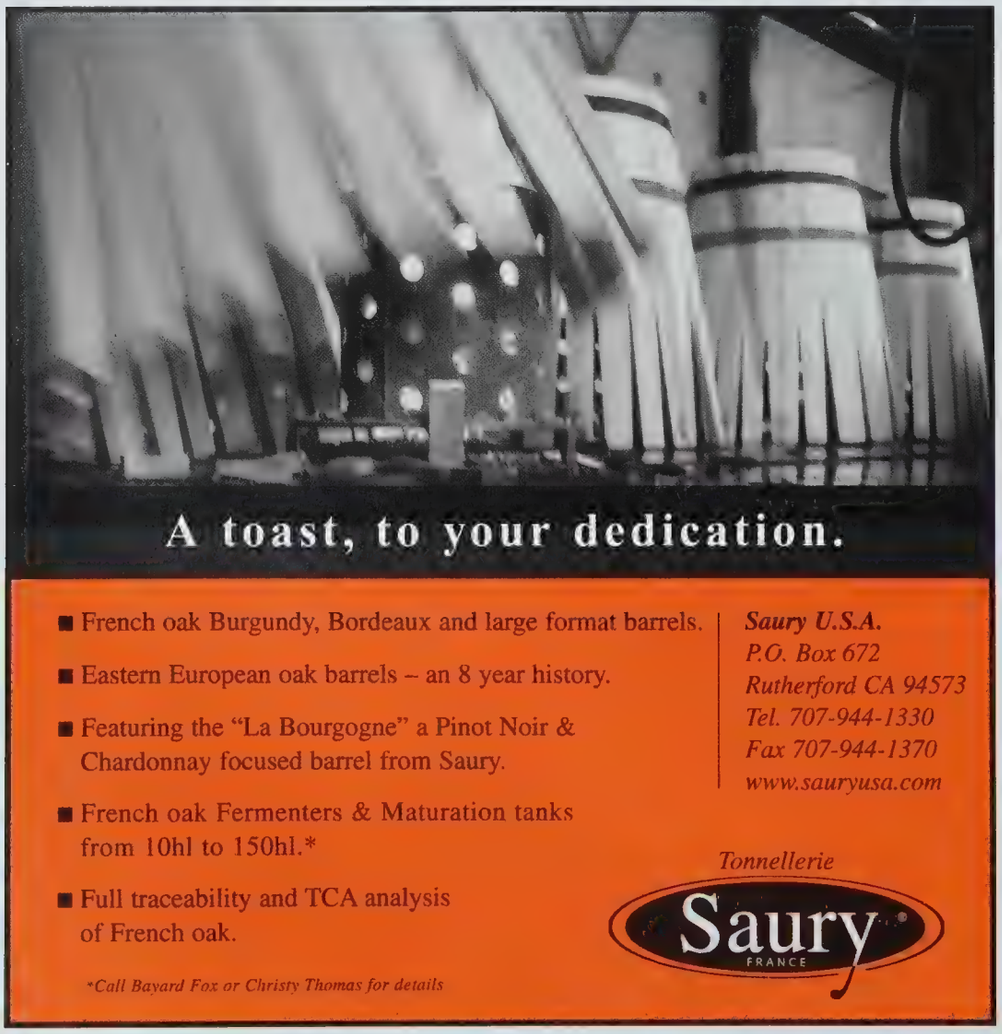
Excess nitrogen — One would expect that if extra nitrogen increased shoot vigor, it might also increase PMBN. One study found that vineyards with excessive manure had more dead buds.[5]

Not mineral deficiency — Several studies found no correlation between PMBN and deficiency of minerals, including nitrogen, phosphorus, potassium, calcium, magnesium, and boron.[5]

Grape Cultivar

Some grape varieties are most susceptible to bud PMBM than others, as seen in our bud dissections.

Most wine grapes have very low percentage necrosis in good years, in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addition to being highly fruitful. Total fruitfulness is typically above 90%, and the majority of buds usually have two or more cluster primordia.

In 2005 in California, when many wine blocks had low fruitfulness, the cause was lack of inflorescence, not PMBN.

At least some varieties tend to have less PMBN in the first several buds, and more in the distal buds. Shiraz, Riesling, and a few other varieties reportedly develop more PMBN than most wine varieties.[5]

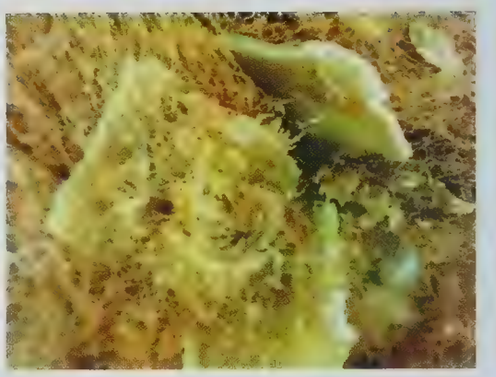
On the other hand, Thompson Seedless vines are highly susceptible to PMBN. Even healthy blocks typically have only 25% to 75% total fruitfulness, and double flower clusters are rare. In addition, the first four Thompson buds normally have less inflorescence and more PMBN than #5 and beyond, which is why Thompsons are cane-pruned.

Flame Seedless also seems to be more susceptible to PMBN than most table grape varieties. Like Thompsons, Flames generally have the most PMBN in the first few buds. Other table grape varieties typically have better fruitfulness and less PMBN than Thompsons and Flames.

Injury-related Bud Necrosis

The plant-mediated necrosis described above is not the only process that can lead to the death of a bud. While examining buds in November and December, our inspectors see many buds sick or dead from processes clearly not involving an abscission layer under the shoot primordia and inflorescence inside the bud. These processes are describable but not well-documented. I have not seen any studies examining these other causes of necrosis.

Our presumption is that these dead or sick buds are the result of injurious processes; such as pathogens, heat- or water-stress, toxic mineral imbalances, or frost. I will refer to them collectively as injury-related bud necrosis (IRBN).



Injury related bud necrosis. The inflorescence appears to be rotting.

In one common scenario, the necrosis appears as a tiny spot on the surface of an inflorescence, or sometimes inside that has a brownish, wet appearance. The necrosis may occur at the base of the inflorescence where it joins the bud or start on the vegetative tip.

In other dissected buds, we see the necrosis spreading to more of the inflorescence, and eventually it spreads to

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Tradition

the whole bud, which eventually dies. This pattern of spreading is reminiscent of a rot pathogen. Our inspectors have never seen any of the filaments or fruiting bodies that are typical of fungi, so if a pathogen is the cause, I suspect it is a bacterium.

Sometimes the entire compound bud will be found badly misshaped, gathered into jagged, reddish, leathery protrusions. The majority of buds on a cane may be in this condition. When we see this in late fall, the cause cannot be determined. My guess is that the cause is some extreme stress, such as high temperature without adequate water or salt, or heavy mite or insect populations.

In 2007, I examined buds from a few ranches after a January freeze. In some vineyards, the freeze did not seem to have a significant effect, but in at least one vineyard, I saw damage that appeared to be recent and possibly attributable to frost. Grapevines are a temperate climate plant and fairly tolerant of cold winter temperatures.

We cannot always identify the cause of necrosis when we examine the buds in late fall, but every year we learn more and glean more information from the appearance of the buds. We can, at least, provide a grower with some clues about whether low fruitfulness resulted from a failure of inflorescence, plant-mediated bud necrosis, or some injurious process.

Bud Mites

Bud mite is a strain of the grape Erineum mite, *Colomerus vitis,* an extremely tiny pest in the rust mite family, Eriophyidae. Materials registered to treat for rust mites should work on bud mites. The Erineum mite strain, which causes white swellings on grape leaves, is rarely seen in commercial vineyards because it is controlled by sulfur. The bud mite strain hides in buds, so it is only exposed to sulfur and other pesticides for a brief period of one or two weeks following bud break.[6]

Bud mites cause damage from the outside in. They typically first appear inside the outer green layers of the bud, eventually working their way into the inforescence and vegetative tip in the middle. One bud may have hun-

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Benefiting from Grape Bud Analysis

Bud fruitfulness may be predicted before pruning by using grape bud analysis (GBAnalysis) — dissection of the buds under a microscope to count flower cluster primordia. Some analyzing services also rate the sizes of the primordia. The main purpose of GBA is to help growers decide how many canes or spurs to retain on the vine and how many buds to leave per spur.

In many years, GBAnalysis will merely confirm the typical fruitfulness of the vineyard and not change pruning decisions. But when fruitfulness is higher or lower than normal, a GBAnalysis can give a grower a warning in time to make changes.

By using GBAnalysis, growers can be confident they do not need to leave extra spurs as insurance against low fruitfulness. In a normal year, this may save on thinning costs. But when fruitfulness is in low, growers will be forewarned to consider tactics to increase the amount of fruit, such as leaving more or longer spurs or adding one or more "kicker canes."

Sometimes a GBAnalysis can provide clues about the cause of low fruitfulness. If many buds are healthy but have no inflorescence, the low fruitfulness was caused by failure to differentiate early in the previous year. This means conditions in early spring were to blame. If many buds are dead, the cause was necrosis, and conditions in late spring or summer were responsible.

In one case involving a block of Red Globe table grapes, a GBAnalysis found very low fruitfulness in the first five buds but good fruitfulness in more distal buds. Not only was the grower warned in time to leave some canes to obtain a crop, but he was able to trace the probable cause to a change in sprays at bloom.

In 2006, growers throughout California saw low fruitfulness in their vineyards. Those who had a GBAnalysis were forewarned and able to modify their pruning to obtain the most from a sparse crop.

Accuracy of a GBAnalysis depends mainly on the grower providing a sample of spurs or canes that represent what will actually be left on the vines after pruning. If the sample is biased towards either good or bad spurs, so will be the results.

A typical sample size is 20 spurs or canes per block. Usually, analysts look at four buds on each cane or all the buds on a spur. This sample size is adequate to track fruitfulness from year to year and to judge whether the crop load is normal, high, or low. Larger samples would be needed to discern modest differences between blocks or to calculate a precise number of expected clusters per vine. Precision depends on the number of samples, not the number of acres. Samples can be combined from two or more blocks of the same variety with similar soil and growing conditions to give more precise results.

More suggestions on taking samples are available on the website of Advanced Agricultural Services, www.advancedagriculturalservices.com/grapebuds.htm.

dreds of mites, but they cannot be seen without a good microscope.

Damage to the outer layers is of no consequence; thus many buds may be infested without damaging the crop if mites reach the middle, they may start to damage the surface of the inflorescence or the vegetative tip. The damage map appear as bubbly protrusions or as hard brown scars. Damaged inflorescences may emerge and form flower clusters, and the grower may not know that those clusters would have been larger without the bud mites.

The worst infestations will destroy flower clusters and prevent emergence of the shoot. Infestations with 5% of inflorescences damaged or destroyed are not uncommon. The most serious populations can damage or destroy 50% or more of the inflorescences.

Shoots sprouting from infested buds may have short internodes and a zig-zag growth pattern. South African researchers have posted pictures.[9]

Some grape varieties are more susceptible to bud mites, and the problem might be more serious in some growing districts. We have seen few if any bud mites in winegrapes grown in Napa, Sonoma, and Lodi districts, among others.

We have seen serious infestations in table grapes in Kern, Tulare, Fresno, and Imperial counties. Highly susceptible varieties, in our experience, include Flame Seedless, Autumn Royal, Black Seedless, Crimson Seedless, and Princess Seedless. Thompson Seedless is moderately susceptible, and we have seen only a few bud mites on Red Globes.

Predatory mites *(Phytoseiidae)* do eat Erineum mites, but biological control of bud mites is not well-understood.[7] Bud mites are exposed to predators during the same short period as they are exposed to sprays, right after bud break. In addition, bud mites hide under new leaf bracts for a few weeks while they wait for new buds to form. Predatory mites can probably reach some under the leaf bracts, and on the outer layers of the new buds.

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Some materials are harmful to predatory mites, including fungicides in the dithiocarbamate class (Dithane, Ziram, Maneb, etc.), Benlate, lime sulfur, Lorsban, pyrethroids, and some other insecticides.[7] Many of these materials are typically applied just before and after bud break to control *Phomopsis*, mealybugs, or other pests. Possibly this could contribute to increased bud mite problems. On the other hand, we have observed reductions of about 50% in bud mite infestations in the year following pre-bud break application of Lorsban, compared to nearby unsprayed vine rows.

Bud mite feeding causes bubbly or dark scars on the leaf primordia and inflorescence. Even at this magnification (30x), the mites can barely be seen.

In one study, some bud mites were found under the stipular scales of next year's bud primordia one week after bud burst. By four weeks, 50% of the population was protected under the scales, and by 10 weeks, 100% was in the buds.

The Australians have studied control of bud mites with sulfur. The best timing was during the week following bud break. The rate was 200g per 100 liters of 80% wettable sulfur, using a "high volume," (about 1.75 lbs. per 100 gals). The researchers did not experiment with different rates or volumes.[7]

Two growers I work with have tried wettable sulfur just after bud break, but we did not find noticeable reductions in bud mites in the following year.

Bud Dissection and Pruning

The final step in determination of fruitfulness is pruning, which is the step most under a grower's control. Pruning can be adjusted if the grower has knowledge of the number of fruit-

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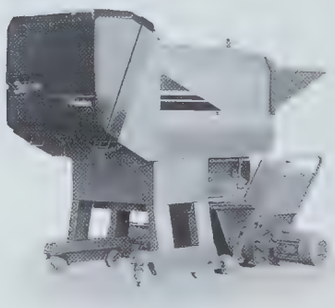

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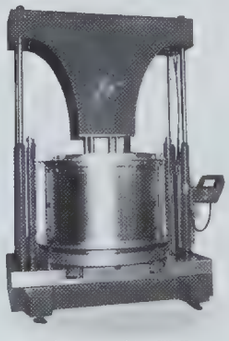

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ful buds and their location on the spurs and canes. This information can come from analysis of bud dissections.[10]

Growers should be careful using bud dissection results to estimate yield. Studies have found that bud dissections may explain from as low as 50% to as high as 90% or the variation in actual yield.[4] Several years of data comparing bud dissections to actual yield will help growers interpret results with more confidence.[10]

Bud dissection sometimes strongly underestimates bud fruitfulness.[11] This suggests that tiny inflorescences overlooked by inspectors may still produce clusters. Also, a random sample of all canes on a vines may show lower fruitfulness than a sample of the stronger canes favored by pruners. Growers must be careful to take a sample representative of the canes they expect will remain on the vine after pruning.

If bud analysis is accurate, a grower can calculate the average number of flower clusters per vine for different numbers of spurs or canes. Of course, there are limits to the number available. When pruners leave more spurs or canes, they may include more of the weaker or sub-standard choices.

Bud analysis can tell which nodes have the most fruit. If the buds on a 2-4 bud spur are unfruitful, longer spurs may be needed to include more fruit, or the grower may need to add a "kicker cane" or two.

However, because of apical dominance caused by auxins moving out along the spur, leaving more nodes on the cane tends to suppress sprouting of the nodes near the base.[11] For example, if the first two buds have more fruit than the next two, retaining the fourth bud in pruning may actually reduce the number of bunches by suppressing bursting of the first bud. The grower needs accurate knowledge of which buds will bring the best return.

Growers are also leery of adding extra nodes on spurs (three or four bud spurs), because that makes the vines taller and harder to prune the following year.[11] ■

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Inflorescence Differentiation

Virtually all of the material on inflorescence was taken from research and literature reviews given to me by

Dr. Luis A. Sanchez, who studied bud differentiation for his Ph.D. dissertation at U.C. Davis and now works for E&J Gallo Winery. The Srinivasan paper is also a good review, but Dr. Sanchez includes that information in his review. Dr. Sanchez kindly reviewed the present paper.

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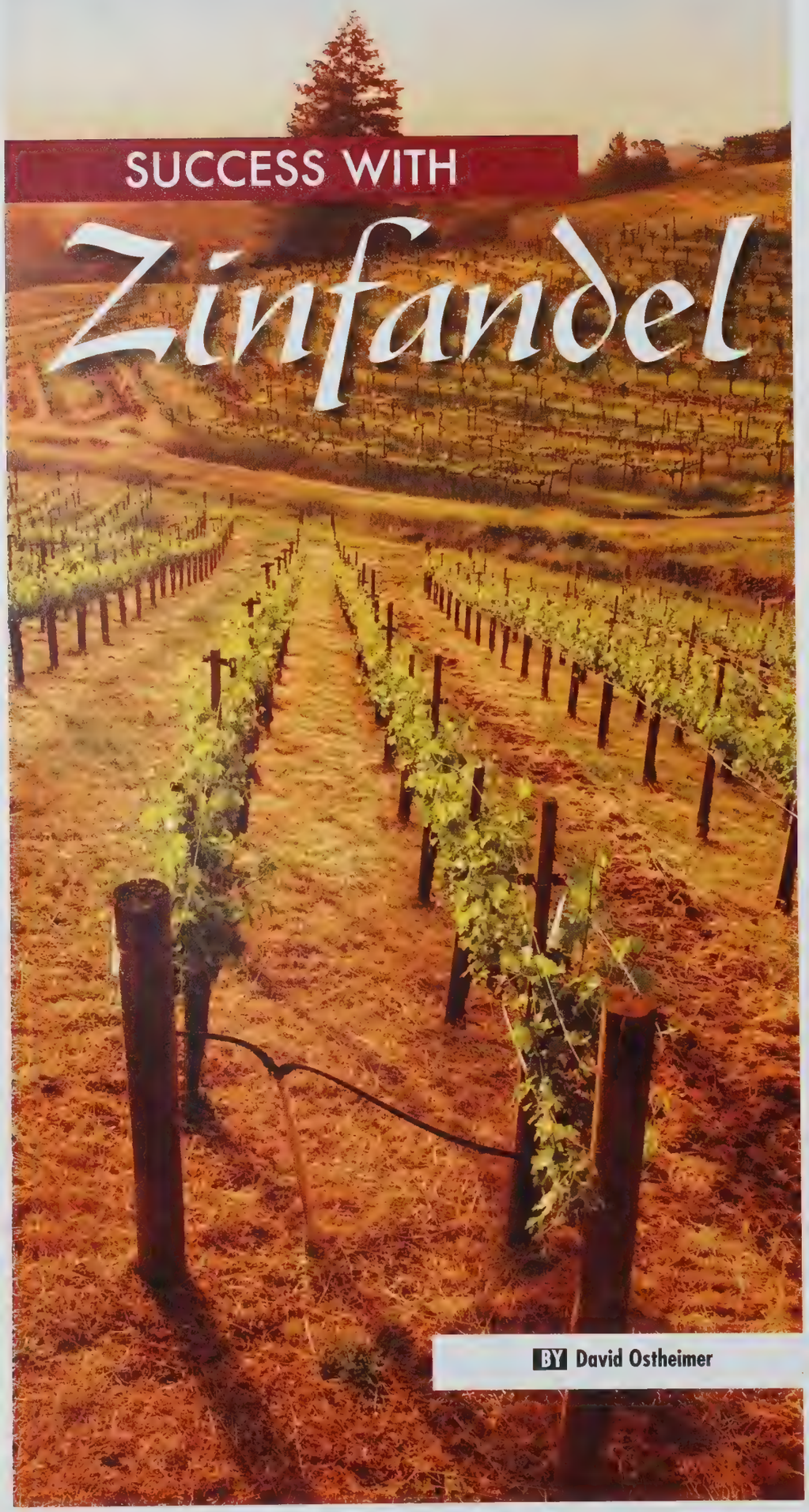


Spacing in this Zinfandel block is a 4-foot wide middle between vine rows, and 8-foot wide tractor rows.

BY David Ostheimer

Zinfandel production had a long history in the northern part of the Napa Valley, where in 1976 Jerry and Sigrid Seps acquired part of an abandoned vineyard begun in the 1880s by German immigrants.

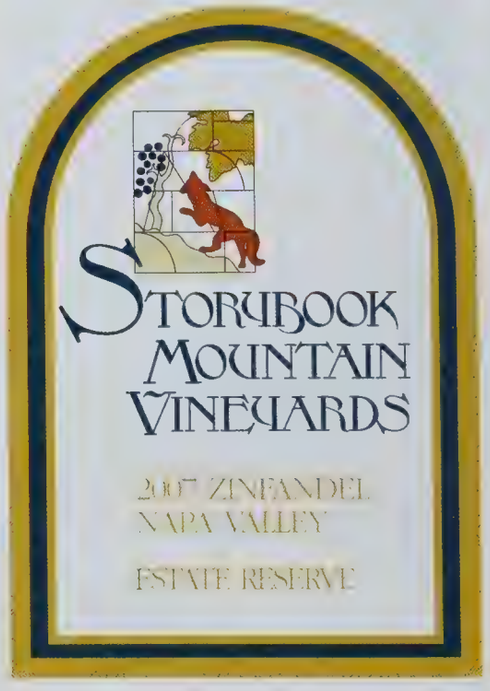
Jerry Seps also had a history in the wine industry. His father worked for Young's Market and his grandfather sold wine at retail. During college and graduate school, Seps worked as a sommelier at the Ahwahnee Hotel and the Wawona Lodge in Yosemite Valley.

Although at the time of the purchase, he was working as a professor of European History at California State University, Dominguez Hills, he felt the tug of Napa Valley.

In 1975, the Seps began looking for property where they could raise a family. Little did he know that his decision would forever position him as one of the leading Zinfandel producers and advocates in California; he served as the first President of Zinfandel Advocates & Producers for five years.

Finding Storybook Mountain

In 1976, Seps met a consortium of attorneys with an investment property



Jerry Seps dumps and sorts Zinfandel grapes into a destemmer.

Tractor rows in this hillside vineyard block are 14 feet wide to allow equipment access around rocks.

for sale on the northern end of the Mayacamas Range, in Calistoga. A partnership was born and Seps, financed by the consortium, purchased 90 acres of the current 100+ acres that now comprise Storybook Mountain Vineyards.

Included in the sale was a defunct winery (last used in 1964 before the Palisades fire), complete with 5,000 square feet of wine caves dug deeply into a volcanic red clay soil hillside. Through sheer determination and sweat equity, Seps paid off the loan and achieved full ownership in just 10 years.

The Napa Valley wine industry of the 1970s was open and helpful. Shortly after Seps acquired the property, Al Brounstein (Diamond Creek Vineyards) began storing barreled wine in the Storybook caves, providing seed money to fix up the caves for proper storage in exchange for space.

Focusing on Zinfandel

As his business plan began to form, Seps continued to research grapegrowing and winemaking options for his newly acquired profession. What grape variety to plant and how to make it into wine were just two of many basic questions facing this new addition to the renais-

sance of the Napa Valley wine industry.

"Plant Chardonnay" was a common suggestion, but that did not feel right to him, given the red clay loam volcanic Aiken series soils on steep east-facing hillsides in the coolest vineyard in northern Napa Valley.

After evaluating soils and climate and an informative meeting with Andre Tchellistcheff, Seps committed to producing Zinfandel. Now that the wine piece was determined, Seps offered his services to Joe Swan for the 1979 harvest in exchange for the opportunity to learn winemaking and operations expertise from the "Dean of Zinfandel." Shortly after, Seps partnered with Walter Schug and, over a three-year period (1980–1983), Schug provided operational support, while Seps provided a place for Schug to start making his own wine.

A focus on Zinfandel continued for 16 years (1980–1995), beginning with 20 acres of trellised and head-trained Zinfandel vines. As the business progressed, a solid strategy emerged, based on a target production of around 7,000 cases, with a maximum of 10,000 cases (the average has been around 5,000 cases). The maximum of 10,000 cases was based upon the capacity of the existing caves.

In the vineyard

No vines existed on the property at the time of purchase. Today there are 43 acres of vines on Storybook Mountain. Blocks that are not infected with oak root fungus or other pathogens, yielding more than 1.5 tons per acre are retained. Blocks with pathogens are removed, often kept fallow for one year, then replanted. Blocks yielding less than 1.5 tons per acre are considered no longer economically sustainable and thus destined for replanting.

One acre or more of vines is replaced each year. Subsequent plantings have been predominantly Zinfandel and, predominantly trellised, with only 20% currently planted as head-trained vines.

Realizing that Zinfandel is a temperamental grape requiring good air circulation and good sun exposure to ripen fully and evenly, Seps feels that the bilateral cordon trellis usually works best.

He continues to replant to trellised Zinfandel replacing head-trained. Older Zinfandel blocks are on 8x12 spacing (450 vines/acre). Replants are generally on 4x8 spacing (850 vines/acre). All new blocks are now irrigated, with only about 10% of the vineyard routinely dry-farmed (the lower slope portion of a hillside Zinfandel block).

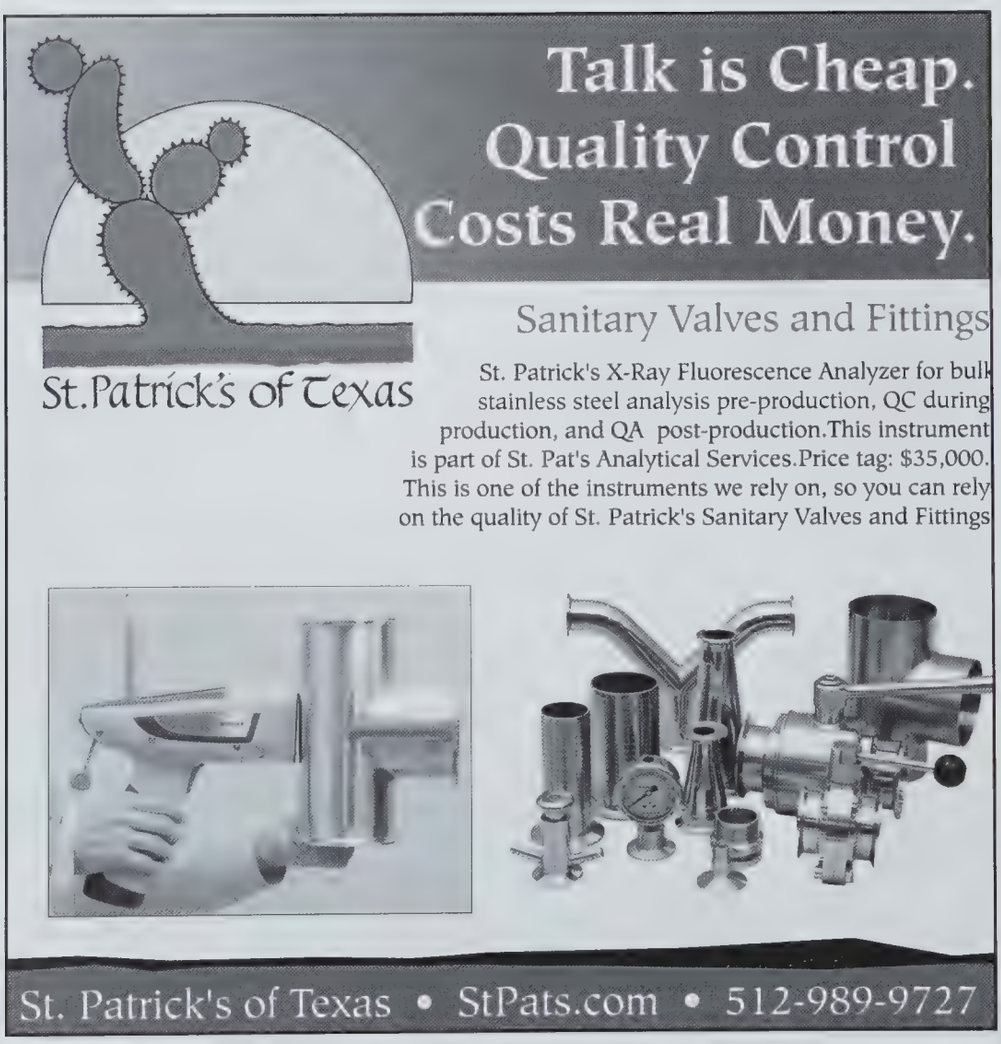
Zinfandel is planted primarily to the Handel clones (1A, 2, and some clone 6) on nine rootstocks. Storybook has one of the largest AXR-1 plantings in Napa Valley (approximately 26 acres), but has 110-R and 1103-P in some of the drier areas for Zinfandel, and 101-14 and 5C in the wetter areas for Merlot. Other rootstocks are St. George and Riparia Gloire.

The vineyards are certified organic. Since Storybook was acquired in 1976, no insecticides or herbicides have been applied. Petroleum-based fertilizers were applied up until 2000. Current vine row weed management is done with a weed wacker, two to four passes per season.

Cover crops are seeded in alternate tractor rows in alternating years. The cover crop is turned under in April or May for nitrogen incorporation.

Fertigation requirements are assessed at three stages. The first is at about 75% of the way through flowering by petiole sampling, the second is six weeks post-set when canes are measured and evaluated, and the third is based on crop yield and visual vine health at harvest.

Pruning begins at the top of the hills (1,200 feet elevation) as those vines will hopefully ripen first, and finishes at the bottom of the vineyard (600 feet elevation) for later ripening. The three-month pruning process is usually completed by the end of March, leaving 5 to 6 spur positions per cordon-arm and 10 to 12 spur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positions for head-trained vines. Two-bud spurs are standard.

First suckering occurs in May (prior to set), and the crown is cleaned out shortly after set. Leaf removal occurs in the eastern-exposed side of the vines and in the areas that are particularly shaded. For head-trained vines, leafing occurs in the middle of the vine. Shoot removal is done on shoots less than 12 inches long. On shoots 12 to 16 inches long, one cluster is retained; on 16-inch long shoots, two clusters are retained.

On some hillsides, double rows of cordon-trained vines are planted. The east-side row has the fruiting wire at 30 to 33 inches above ground, while the west side wire is higher (43 inches above ground) to capture the morning sun. The west side of the lower row is protected from the afternoon sun by the uphill vine — and similarly up the hill.

A green drop occurs at about 75% veraison. Green clusters, those with uneven color, and wings in crowded areas are removed. Prior to harvest, sunburned and raisined fruit clusters (with greater than 25% raisins) are removed.

All fruit is hand-harvested and hand-sorted into 40-lb lug boxes. A final inspection occurs at the crusher. The 43-acre vineyard is divided into 95 separate blocks for pruning, irrigation, and picking; allowing for a steady and even harvest progression.

Achieving wine style goals

The overarching wine style objective for Storybook Mountain wines can be summed up in one word: balance. Specifically, Seps and daughter Colleen are making wines that have intensity without being too heavy, and that have seductive aromas and flavors without being pruney or porty. They want fresh blackberry fruit and jam with a touch of plum, and some black pepper and spice at the back of the palate.

To achieve these style goals, picking decisions are critical. Seps and Colleen look at the numbers (Brix, TA, pH), and seed color (something Seps has done for 20 years). The team also performs a visual and organoleptic evaluation of the fruit in the vineyard, looking for the skins to barely slip off the pulp, and a slight pinking of the pulp itself. Final evaluation involves the flavors in the mouth and tannin development of the skins.

Harvest typically starts in mid-September and Zinfandel grapes are picked over six weeks, utilizing 16 fermentors once or two times per harvest.

Once the fruit is picked, no more than 40 minutes pass before it is brought into the winery where it is crushed (rollers out), destemmed, and sent directly to a jacketed tank. The majority of tanks hold five tons (a nor-

mal day's harvest). Forty ppm SO_2 is added to the must at the crusher.

No enzyme or tannin additions are made to any wines. Four hours after the fruit gets into the tank, some of the juice is removed (4% to 8%). This saignée volume is the core of the winery's Vin Gris program, which creates 200 cases of barrel-fermented rosé.

The remaining must undergoes a cold soak for 72 hours at 57°F. Specially designed tanks have glycol jackets on the bottom/underside to quickly chill the fruit. Once the tank is full, a pump-over (100% to 200% of volume) is performed to mix the fruit and SO_2, samples are pulled for analysis, and subsequent additions calculated.

Following cold soak, the must is warmed to 70°F. In order to facilitate a normal fermentation, the must may be adjusted. After using Pasteur Red yeast for the first 10 years, a transition was made to using only indigenous yeast. Final alcohol targets are generally below 15%. Primary fermentation lasts between 18 and 19 days at 69° to 72°F, reaching a peak temperature of 80° to 85°F for 48 to 72 hours.

Three nutrient additions are made between the onset of fermentation and 10° Brix with Superfood and diammonium phosphate, to achieve a YAN (yeast assimilable nitrogen) target of 300 to 350 ppm.

Each lot receives two or three pump-overs per day until 12° to 10° Brix. Each tank receives four rack and returns during the course of fermentation, with the first three occurring early in the fermentation and the fourth occurring late.

Draining and pressing wine occurs at dryness (–1.6° to –1.7° Brix). Following pressing, the wine goes to barrel for malolactic fermentation (MLF) and the remainder of primary fermentation.

Press cuts are done by taste, but historic yields of 150 gallons per ton are achieved. The drain and soft press wine are combined and hard press wine is kept separate as a future blending component. Hard press is accumulated for a rough filtration prior to barreling down.

For MLF, a cultured house strain of bacteria is added at a 5% v/v addition. Once the wine is dry and MLF completed (less than 1g/l and less than 0.3g/L respectively), it is racked off the gross lees, and 48 ppm of SO_2 is added.

While the Cabernet Sauvignon program incorporates 100% new, tight-grain French oak barrels from Gamba, Bel Air, Cadus, and Challefour, the Zinfandel program is an equal mix of French, American, and Hungarian oak utilizing tight-grain barrels from Nadalie, Canton, and Seguin Moreau U stave.

Some early lots of Zinfandel may go through MLF in new barrels and then be racked out to used barrels. That decision is based on wine style and development. Cabernet Sauvignon remains in-barrel

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for upwards of 18 months and is racked post-MLF, 2 to 3 weeks later, at six weeks, then as needed..

Zinfandel undergoes three rackings: at one month (aerative), two months (aerative), and six months (non-aerative). Only the six-month racking is a clean racking. Barrels undergo a three-minute ozone wash to help control any spoilage issues. Free SO_2 for each wine is checked twice per month and adjusted to 33 ppm.

A program designation is made after about four to eight months in barrel. That designation can change as blends are compiled and evaluated. On rare occasions, the blend is fined with one fresh egg white per barrel. The wine is filtered at one micron to bottle and SO_2 adjusted to 35 ppm FSO_2. Anything tighter is based solely on micro and analytical lab results.

The Napa Estate, Mayacamas Range Zinfandel (3,000 cases, $35) is the earliest release, spending 12 months in barrel and 4 months in bottle. This is a fruit-forward wine with soft, approachable tannins on the palate and fresh berry fruit in the nose. The 2007 has beautiful blackberry and raspberry fruit, with sweet berry cream and sweet oak aromas. On the palate, the wine is layered with similar flavors and black spice. The wine has nice weight, concentration, and structure with a nicely balanced soft finish.

The Napa Estate Eastern Exposures Zinfandel (800 cases, $45) spends 12 months in barrel and 6 months in bottle prior to release. The wine style is one of bright aromatics, and complexity on the palate. A small addition of Viognier (4% to 10%) introduces some of those elements. The 2006 Eastern Exposure is expressive, exploding from the glass with dark fruit aromas and floral notes. The wine has some characteristics similar to the Mayacamas bottling, with great fruit and great texture.

The Napa Estate Reserve Zinfandel (600 cases, $55) spends 12 months in barrel, and 12 months in bottle prior to release. The wine style is one of distinct layers of fruit and flavor. The 2005 reserve is dark with aromas of ripe black plum and blackberry jam and jelly. An aroma of medium-toast roasted oak prevails. The wine has great power, concentration, and length.

The wines of Storybook Mountain Vineyards weave a wonderful tale of history, passion, and adventure. Jerry Seps set off on a quest more than 30 years ago to discover the world of winemaking, and we are rewarded by his efforts. ■

David Ostheimer is owner and winemaker of David Ostheimer Wines, a wine consulting firm. David also works for Delicato Family Wines in the Custom Resource Group.
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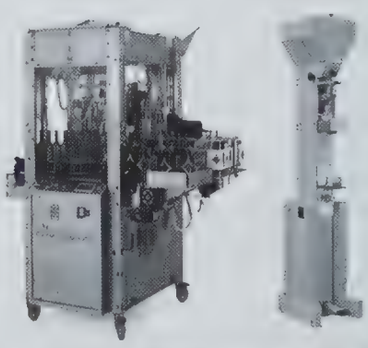

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Oak chips or tannins for improving wine structure and color

BY Paul K. Bowyer,
LAFFORT Australia,
Pooraka SA, Australia

Exogenous tannins have been used in the global wine industry for many years. While some winemakers use tannin additions to improve wine style or structure, and others maintain that tannin additions do not suit their individual wine styles, sometimes they are a necessity.

For example, the heat waves in Australia during the 2008 and 2009 vintages caused severe vine (and therefore fruit) stress, leading to undesirable fruit phenolic structure requiring tannin addition in the wine.

In wine regions where wet weather during vintage is common, such as Bordeaux, exogenous tannin additions are used prolifically, to eliminate the oxidative enzyme laccase (from *Botrytis* infection) and to improve wine structure.

Important distinctions should be made when discussing tannins, as they all differ in terms of chemical functions and organoleptic contribution. Simple wood extracts possess very different characteristics from more complex blended fermentation tannins, such as VR Supra. When using oak chips, tannin must be extracted from the chip itself; when using exogenous fermentation tannins, no extraction step is required.

Oak chips are now in common use in winemaking. Some winemakers have been informed that the tannin extracted from oak chips during fermentation will deliver the same result as an exogenous fermentation tannin addition in terms of wine color intensity and hue, color stability over time, and wine palate structure.

To investigate these claims, LAFFORT, in partnership with a winery in Victoria, Australia, in the 2007 vintage, conducted a winemaking "tannins and oak chips" trial. The primary aim of the trial was to evaluate the relative effectiveness of both oak chips and exogenous fermentation tannin additions with respect to their influence on wine color and palate structural quality.

Tannin structures

Oak tannins are characterized by ellagitannins, which are structurally defined by cross-linked gallic acid units (marked in blue, Figure IA) esterified to a sugar core. The galloyl esters provide the phenolic component of ellagitannins and are able to participate in co-pigmentation to provide an increase in color expression, yet they lack sufficient nucleophilic capacity to covalently combine with (and thus stabilize) anthocyanins.

In comparison, VR Supra contains both resorcinol and phloroglucinol-based phenolics (Figures IB and IC), which display far greater nucleophilicity due to the *meta*-positioning of the hydroxyl (OH) groups on the aromatic ring, allowing them to effectively combine with anthocyanins, leading to color stabilization and palate modification of a wine.

Based on the differences in the tannin structures of oak chips and exogenous fermentation tannins, it was anticipated that there would be significant differences in the wines produced from this trial in terms of color development and stability over time, in addition to palate structure.

With oak chips, the nature and amount of tannin extracted depends on four factors: alcohol concentration of the must, temperature and duration of fermentation, and fermentation management practices. The toast level of the wood plays a role in the amount of extractable tannin in oak chips, since phenolic materials in the wood are converted into aromatic compounds during toasting, such as vanillin and guaiacol.

Figure II illustrates the relationship between the toasting level and amount of extractable tannin in an oak sample. For maximum structural contribution, a lightly toasted chip should be used; while for maximum aromatic contribution, a heavy toast should be used.

Trial outline

The wine in the trial was a wine in the $10 to $15 per bottle range, which would typically spend 12 to 18 months

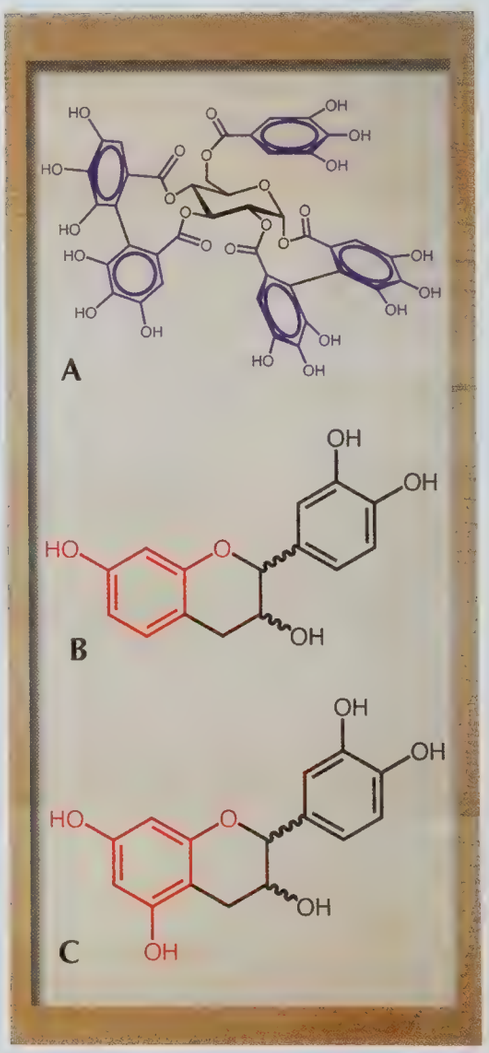

Figure I: Example structures of ellagitannin derived from oak (a) and the resourcinol-based (b; resourcinol core in red) and phloroglucinol-based (c; phloroglucinol core in red) tannins found in VR Supra and VR Color.

in barrel. Shiraz was sourced from the Bendigo region and was harvested at 25° Brix. Five 5.5-ton ferments were conducted: three different tannin additions, an oak chip treatment, and a control (no addition).

The three tannins examined in the trial were LAFFORT VR Supra and two experimental tannin blends (VR Color and Blend-2). Tannins (300 ppm) were added at the first pump-over, with pump-over twice daily.

Medium toast American oak chips sourced from the usual supplier used by the winery were added to the must (3 kg/ton).

All fermentations were yeast-inoculated and conducted under the same operating parameters at temperatures of 71°F to 79°F. Malolactic fermentation (MLF) occurred with indigenous microflora, with final malic acid concentrations less than 0.1 g/L.

Final wine parameters (with only minor variations between treatments) were: alcohol 14.0 %; TA 6.8 g/L T.A.E.; pH 3.6; RS 1 g/L; 25 ppm FSO_2; 40 ppm TSO_2; VA 0.25 g/L.

Table I: Initial sensory analysis preference ranking and comments for wines (April 2007).

Wine Treatment	Av. winemaker ranking	Winemaker comments
Oak chips	1	Sweet fruit; some flesh; more density and weight
Blend 1	2	Medium weight; clean & round; good structure & density; some grainy tannin
Control	3	Medium weight fruit; soft; bit herbal; balanced tannin
VR Supra	4	Plain; tannins up-front; bit short; thin
Blend 2	5	Palate grippy; obvious tannin; some harshness; lacking fruit

1 = most preferred, 5 = least preferred.

The wines were each placed into two 500-liter four-year-old puncheons to provide a barrel maturation environment without significant intrusion of oak character. The winery laboratory conducted periodic color analyses and blind sensory assessments (employing simple preference ranking of 1 to 5, where 1 = most preferred) over 14 months.

Post-MLF results, May 2007

Immediately post-MLF, Somers color analyses of the wines were conducted at the University of Adelaide. The data represents a snapshot of the wines very early in their production life, which is when some winemakers evaluate such trials. The continuous

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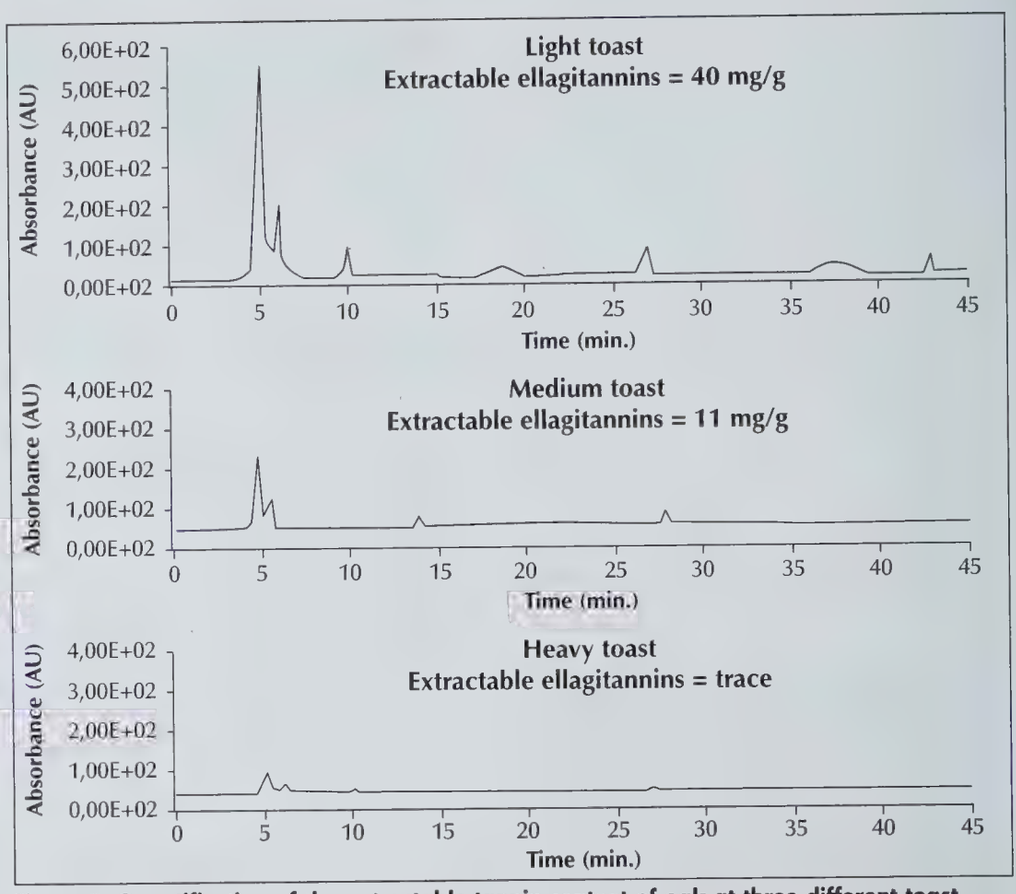

Figure II: Quantification of the extractable tannin content of oak at three different toast levels, illustrating the inverse correlation between extractable ellagitannin and toast level.

analytical data detailed in the following sections serve to illustrate the value of long-term trials, given the changes observed over time.

The initial color density (intensity) of the wines (Figure III) indicated minimal initial difference between the control and oak-chip treated wines. All tannin additions contributed a significant boost in color intensity (9% to 21% over the control). Initial wine hue — the ratio of brown (A_{420}) to red (A_{520}) coloration in the wine — indicated minor differences between treatments, with the control being the reddest wine and the oak-chip treated wine having the brownest color (Figure IV).

The phenolic content of each tannin-added wine was higher than the control (Figure V), with gains of 22% to 28% in phenolic content over the control. The oak-chip treated wine, in comparison, gained only 7% phenolic content over the control. Thus, oak chips delivered only 25% to 32% tannin compared with the wines containing exogenous fermentation tannins. This is an important difference in terms of wine structure and phenolic load, with color and quality ramifications that would become evident over the duration of the trial.

Initial sensory assessments of the wines in late April 2007, conducted blind by five winemakers, are in Table I. The comments indicated that, post-MLF, the oak-chip wine was the most acceptable in general terms, although all winemakers agreed that since it was the only wine showing oak character this skewed the preference significantly.

Comments on the wine mouthfeel indicated a certain level of tannin aggressiveness in the wines where the VR Supra and Blend 2 tannins were added. The exception was the initial ranking of the VR Color-treated wine rated #2 in this early stage of the trial. This is a significant result, and indicates that not all fermentation tannins contribute to wine astringency to the same extent.

June 2008 color analysis

The winery conducting the trial supplied its own color analysis data, based on the Somers color measures.

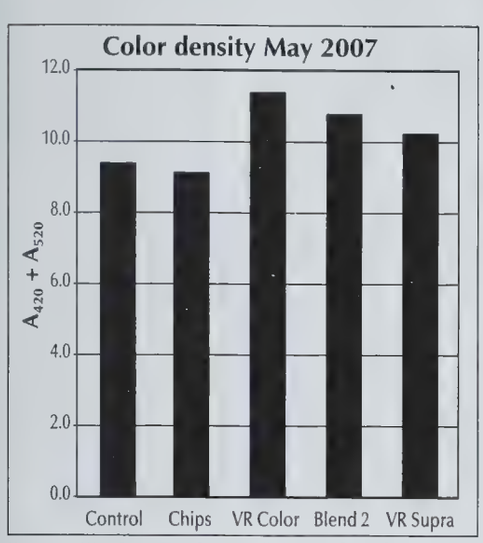

Figure III: Comparison of the color density (intensity; $A_{420} + A_{520}$) for the wines (May 2007). All tannin-added wines had increased color density compared with the control and oak chip-treated wine.

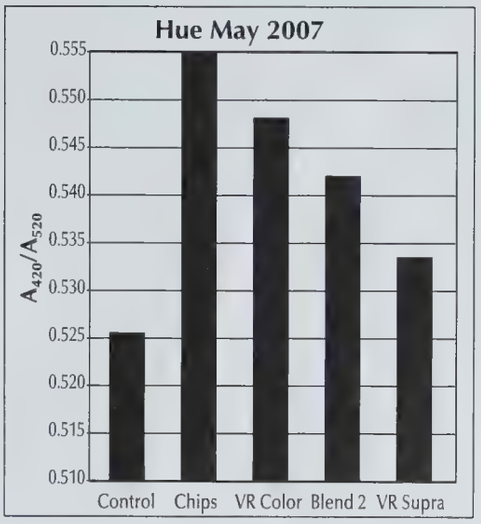

Figure IV: Comparison of the hue (ratio of brown: red; A_{420}/A_{520}) of the wines (May 2007). The wine made with oak chips had the brownest coloration.

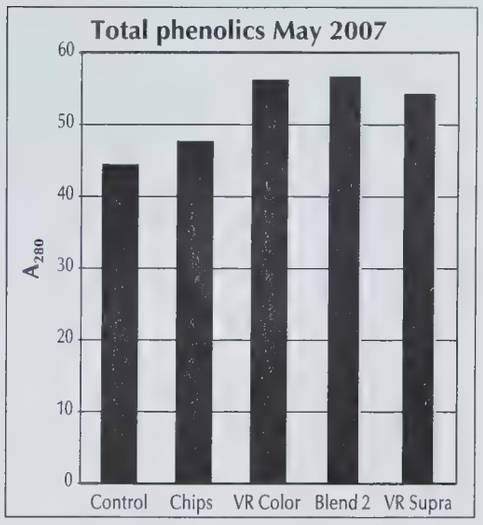

Figure V: Comparison of the phenolic contents (A_{280}) of the wines (May 2007). Values are directly proportional to the phenolic loads in the wines.

COLOR DENSITY

Figure VII shows the color density analyses over the following months of the trial up to June 2008. The oak-chip treated wine improved in color intensity, presumably due to the non-stabilizing co-pigmentation effect. The control wine also improved marginally over the trial period. The tannin-treated wines all showed approximately the same color intensity,

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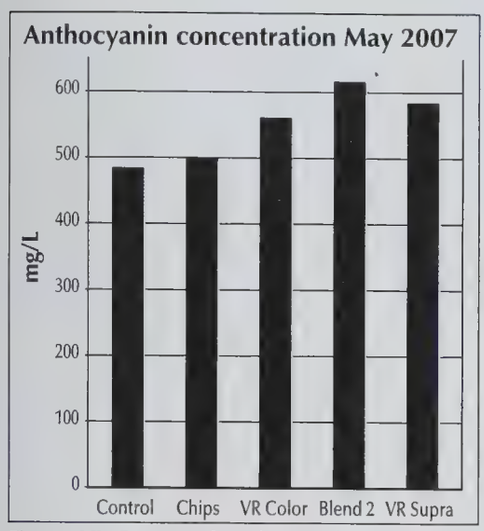

Figure VI: Corrected anthocyanin concentration of the wines as measured by spectrophotometer. Wine anthocyanin content is clearly elevated in the wines made with fermentation tannins.

which was significantly greater than either the control or oak chip-treated wines.

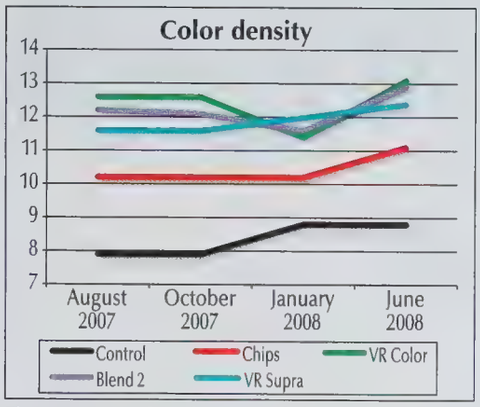

Figure VII: Color density of the trial wines over the duration of the trial.

Hue

Although wine hue varied initially across treatments after 14 months, there was remarkable similarity between the tannin and oak-chip treatments (Figure VII). The control wine, in contrast, took on a noticeable brown coloration over time. This was presumably a result

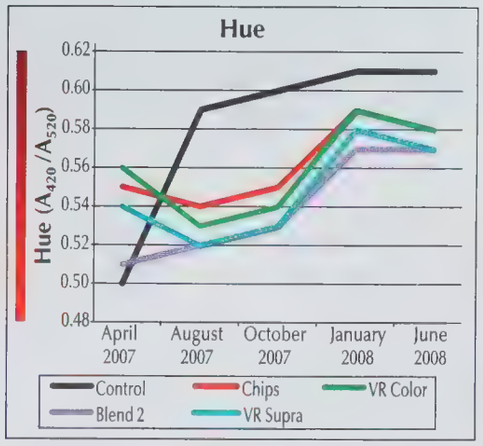

Figure VIII: Hue of the trial wines over the duration of the trial. The color bar to the left gives a nominal indication of the chart scale as it pertains to color.

of the lower phenolic content of the control wine, combined with the use of older barrels for maturation, which would contribute minimal tannin to the wine, thus lowering its overall antioxidant capacity.

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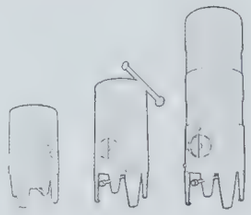

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Phenolic content

Noticeable and consistent differences in phenolic content were observed between the tannin-treated wines and the control and oak-chip treated wines over the duration of the trial (Figure IX). These differences were found to reflect the sensory evaluations with respect to palate structure (see next section). The data indicate that minimal phenolic material was extracted from oak chips during fermentation, and that a far greater phenolic contribution was made to the wines through the tannin additions.

Wine preference

Figure X indicates the changes in averaged winemaker wine preference over time. The control wine was ranked third post-MLF because it was not harsh and had reasonable color at the time. It moved to fifth place, in concert with the development of some brown pigmentation through passive oxidation, indicating insufficient phenolic antioxidant protection (insufficient phenolic content), and a generally deficient wine structure for this wine segment.

The oak-chip treated wine was initially ranked first, but declined to fourth place over the 14-month trial, as it became apparent that it was lacking in both depth of color and palate tannin structure. Comments from the January 2008 sensory assessment (Table II), when the wine preferences began to stabilize, reflected that the oak-chip treated wine was showing noticeable resinous "chip character," and that the control was now looking "dull and thin."

The wines with added tannin appeared to go through a transition phase at around four to six months post-ferment, where preferences varied dramatically, indicating some structural changes in the wine.

Given that the wine style targeted for this trial required the wine to be in barrel for 12 to 18 months, this is a highly significant result. The structural changes indicated by the sensory analyses in the four- to six-month window suggest that any qualitative evaluation of wine quality or structure within this wine style segment (or a

segment of higher price point) is best left until a period of at least six months post-ferment.

At the conclusion of the trial, the wine made with VR Supra was judged to possess the best overall quality and structure. Although the VR Color tannin was ranked second, in fact it scored very close to the VR Supra wine. The wine made with the Blend-2 tannin was ranked third upon trial completion.

One of the most significant differences between the two commercial tannin treatments (VR Color and VR Supra) was that the VR Color-treated wine was, immediately post-MLF, very favorable in terms of wine structure, whereas the VR Supra-treated wine required more maturation time to develop its final wine structure. This suggests that VR Color may be better suited to wines requiring a rapid turnaround time, or where a variety is being used that responds more positively to a softer fermentation tannin contribution.

Table II: January 2008 sensory analysis preference ranking and comments for trial wines.

Wine Treatment	Av. winemaker ranking	Winemaker comments
VR Supra	1	Fresh color; berry fruit; good tannins; more structure
Blend 1	2	Good color; more grip but has structure
Oak chips	3	Chip character
Blend 2	4	Good color; good balance; OK.
Control	5	Light color; dull and thin

1 = most preferred, 5 = least preferred.

Could independent winemakers see and taste the difference?

The winemakers involved were clearly able to observe significant differences between the wine treatments, that was substantiated by spectrophotometric data. Was it then possible for winemakers not involved in the trial to do the same? To answer this question, winemakers from the Riverland wine region of South Australia were asked to evaluate and rank the trial wines in terms of color intensity and the quality of wine structure.

All wines made with tannin additions received better rankings for color intensity than either the control wine or the oak-chip treated wine, which were ranked equal (fourth) [Figure XI]. Given the small sample size (n = 9), absolute rankings are not noteworthy,

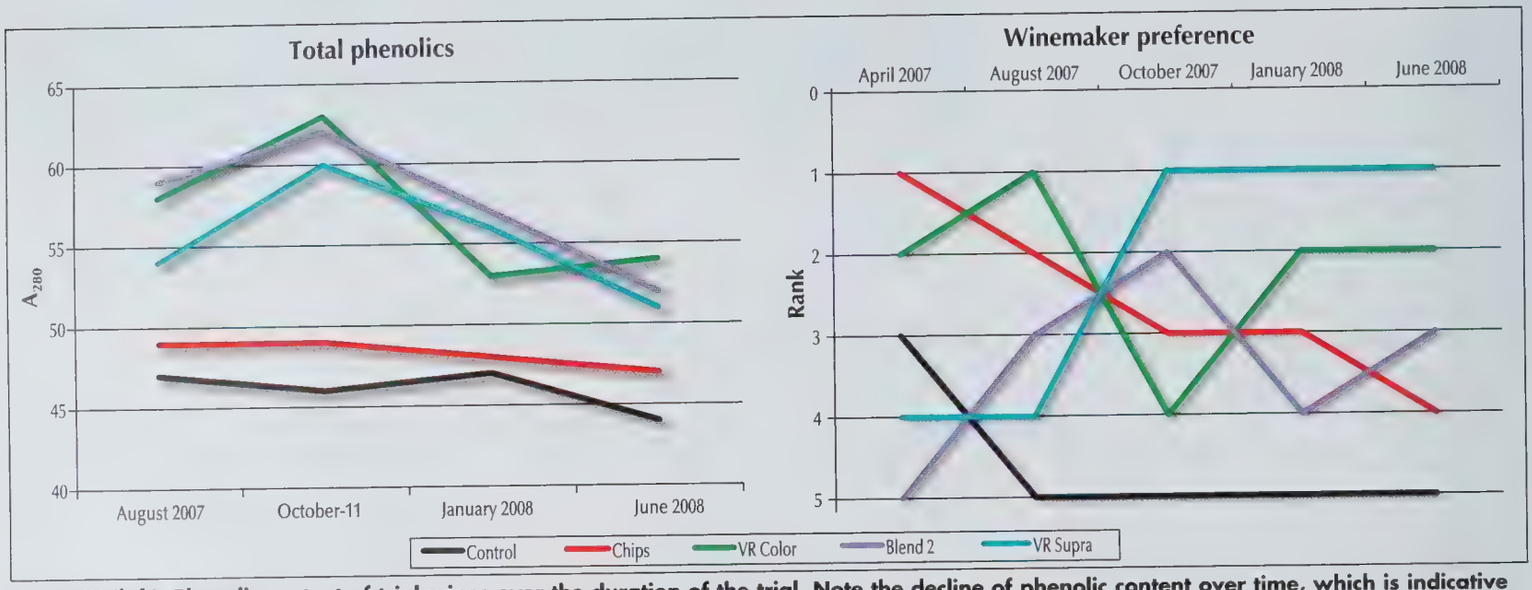

Figure IX (left): Phenolic content of trial wines over the duration of the trial. Note the decline of phenolic content over time, which is indicative of the passive oxidation that normally occurs during barrel maturation of wine. The difference in values between the upper (tannin-added) group compared with the lower (control and oak chip-treated) group is reflective of comments made by the tasters regarding the palate structures of the wines.

Figure X (right): Averaged wine quality preference of trial wines over the duration of the trial. 1 = most preferred; 5 = least preferred. The minimum number of tasters involved at each stage was 5. Note the period between August 2007 and October 2007 (wine age of 4–6 months), where significant preference variation occurred, which was presumably reflective of structural changes in the wines.

but the wines can, nevertheless, be divided into two discrete groups: those with high color intensity (all made with exogenous fermentation tannin addition) and those with low color intensity (made without exogenous fermentation tannin addition).

In terms of an evaluation of wine structural quality (Figure XII), the wines made with tannin additions received top rankings. The least preferred wine on structural quality grounds was the control wine, which agrees with quality evaluations made by winemakers conducting the trial, and also with the Somers color data.

Cost comparison

The cost of the examined additives to make the oak-chip treated wine was around $11.70 per ton. The cost of using the exogenous fermentation tannins was about $5.40 per ton. Oak maturation and oak flavor must still be factored into this equation if required, but since the wines were made for a wine segment where 12 to 18 months barrel maturation is nominal, barrel costs are not so relevant. In addition, given that the premise for

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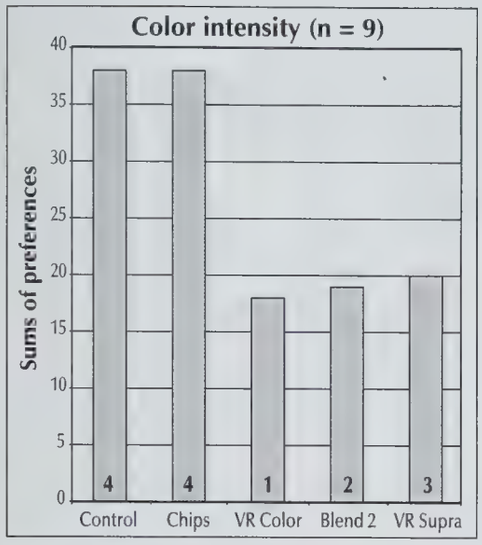

Figure XI: Color intensity rankings for trial wines by independent winemakers (n = 9). Columns reflect the sums of rankings, hence a lower score indicates higher wine color intensity, as noted by the column base labels.

the trial was that oak-chip derived tannins could replace exogenous fermentation tannins, a direct cost comparison seems reasonable.

Summary

While using oak chips can provide some extractable tannin to a wine — which can, in turn, elevate a wine's color intensity through co-pigmentation — it cannot replace the broad spectrum of functions that an addition of exogenous fermentation tannin provides.

Aside from the clear advantages offered by fermentation tannins over oak chips in terms of wine hue (reflective of wine oxidation state) and phenolic load (reflective of palate structure), ellagitannins simply do not possess the required chemical activity to stabilize wine color.

In terms of absolute wine quality, all wines in this trial made with exogenous fermentation tannins were rated above the control and oak-chip treated wines,

Continued on page 90

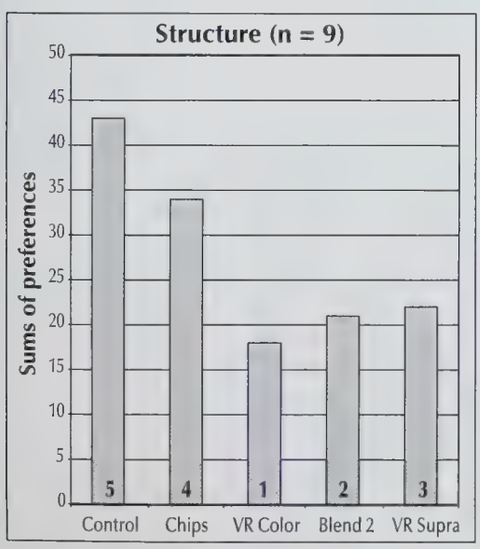

Figure XII: Wine structural quality rankings for the trial wines by independent winemakers (n = 9). Columns reflect the sums of rankings, hence a lower score indicates higher wine structural quality, as noted by the column base labels.

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ENERGY EFFICIENCY SERIES

WINERIES REDUCE ENERGY WHEN UTILITIES DEMAND

PART ONE

BY Tina Vierra

Wineries in California with appropriate equipment, technologies, and good knowledge of their energy demand, can take advantage of Demand Response (DR), an umbrella of energy management solutions, with a number of programs offered by all California utility companies.

When California's electric grid is experiencing high energy demand or transmission constraints, California utility companies can call upon responsive commercial customers such as wineries, to reduce their energy demand on short notice by an agreed amount. In return for their participation, wineries can receive year-round, seasonal, or event-specific financial incentives.

Participation in Demand Response

To help wineries participate in DR, utilities like Pacific Gas & Electric Company (PG&E, San Francisco, CA) provide access to web-based tools like InterAct, which tracks a winery's 15-minute interval usage meter (provided free by the utility), downloads and stores its data, and provides charts, graphs, statistical analysis, and data-export tools the winery can use to track its energy demands and usage patterns.

With the detail provided by InterAct, a winery can analyze its peak demands, decide which of several DR programs best suits its usage patterns and ability to limit or shift its energy use, predict its own peak demand periods, measure against its Time-of-Use utility rates, and then schedule work around peak usage periods to lower-rate hours.

PG&E also provides "Technology Incentives" (up to 50% of the project cost and $125/kW of demonstrable load drop) for wineries to install automation and controls, re-program Energy Management Systems (EMS), or re-tool equipment to make it easier to participate in DR.

Wineries wishing to automate their DR participation can be fitted with a "clear box" that connects to PG&E's communications systems, allowing the winery to receive event notifications via the Internet and directly into their EMS. Customers can then respond to notifications in various ways, and can even choose to override the signal if conditions exist that prevent them from decreasing demand. As with Technology Incentives, Auto Demand Response provides up to $250/kW (up to 100% of the project cost) for controls and equipment.

If a winery is planning short-term energy efficiency projects and/or solar energy installation, it is advisable to finish those upgrades first, and then sign up for DR. Energy efficiency and solar projects will change a winery's energy demand and usage pattern, and may decrease the amount of demand they are able to curtail.

Alternatively, wineries can participate in DR, and then use the money they earn to implement energy efficiency measures and upgrades, and then adjust their demand response participation as needed.

"DR is just one component of total energy management," explains Patsy Dugger, manager of PG&E's Agriculture and Food Processing Programs. "Complete energy management should include energy analysis and measurement, energy efficiency, self-generation, and Demand Response components."

How to reduce winery electric demand when called

A combination of strategies can be utilized to reduce your winery's electric demand during a DR event, including:

- Turn down, turn off, or cycle pumps/pump motors, heating, ventilation, and air conditioning (HVAC) systems, chillers, ceiling fans, intake and exhaust fans, blowers, and any other air circulation motors;
- Turn down or turn off non-essential lighting, decorative features, conveyor belts, battery charging stations and equipment, and all non-essential process and pumping equipment;
- Reduce or slow down production;
- Pre-cool work areas, then cycle constant air volume HVAC units, or temporarily reset static pressure in variable air volume HVAC, turn off ceiling fans and room fans.

Insulated tanks for cold stabilization at Courtside Cellars (San Miguel, CA).

- Apply ventilation control — temporarily reduce or cut off outside airflow completely to reduce cooling demand;
- Schedule day shift to go home early, swing shift to start late, and regular shift to start extra early and shut down at noon;
- Conduct staff meetings during an event to curtail equipment usage;
- Charge battery-operated equipment prior to event, then use during event;
- Stockpile inventory prior to event, then stop production during event, and conduct packaging or storage functions;
- Move batch and continuous processes to either before or after event, or to another day;
- Some facilities with package AC units can do load-cycling, temperature reset, and possibly pre-cooling.
- Reset chilled water temperature.
- Adjust variable speed drive controls to reduce load from fans, pumps, and chillers.
- Decrease use of aerators during an event.

Of the DR programs offered by PG&E, those best-suited to wineries include Critical Peak Pricing (CPP), PeakChoice, Aggregator Managed Portfolio (AMP), the Capacity Bidding Program (CBP), and the Demand Bidding Program (DBP).

NOTE: space permits only some program terms and conditions to be included here. Full information for each plan is available at http://www.pge.com/demandresponse.

COURTSIDE CELLARS (SAN MIGUEL, CA)
Efficient facility

Built in 2000, Courtside Cellars signed up for the DR program in 2004, and is on the Demand Bidding plan. John Guffey (Courtside director of operations) immediately realized the usefulness of the InterAct tool for keeping on top of the winery's energy use.

"The InterAct tool has been invaluable for watching our energy usage very closely," Guffey reports. "The information available is impressive, and was instrumental in helping us determine what areas were high energy consumers. The report most useful to us was load analysis, under the energy and cost analysis menu. We can also review average costs and bill charges by the day."

When Courtside joined the DR program, average energy use was 644 kW per day, with a peak day's use of about 1,100 kW. Guffey and his team have made many improvements to make the facility more efficient since then, with most improvements earning PG&E rebates or incentives.

In 2005, Courtside added a barrel room with incentives from PG&E's Non-Residential New Construction program, installed T5 lighting on a split system (turns on or off in thirds), and premium efficiency motors in the air handling units. Also in 2005, they retrofit the humidity system in the original barrel room — the old system used pressurized air from a 75 hp air compressor. A 2.2 hp

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high-pressure turbo pump was installed in the humidity system, and the humidity feed lines were changed out as needed to meet requirements of the new pump. At a cost of about $17,000, the project earned a $7,400 incentive and saves the winery 92,942 kWh of energy per year.

In 2007, 320 metal halide lights were changed to T5's, and another barrel room was retrofitted for white wine fermentation. The new fermentation room has CO_2 removal fans with variable frequency drives (VFDs) – the speed of the fan is controlled by the CO_2 level in the room, cycling only fast enough to expel dangerous air and maintain a safe environment, and eliminating the need to allow hot outdoor air into the room through open bays, doors, or windows.

Courtside has automated night-air cooling in nearly every production area, timers and automated dissolved oxygen control on process pond aerators. A VFD added to the glycol booster pump in the barrel room saves 34,000 kWh per year, at a cost to the winery of $6,600, which earned a $2,700 utility rebate.

The winery has a separate chiller and glycol tank, pump skid, and a dedicated set of two feed-and-return glycol lines to nine insulated tanks for cold stabilization. The "cold loop" is run from an existing compressor with a new set of refrigerant lines, with the compressor able to switch back and forth, running the cold loop or the main refrigeration system as required.

"The 'win' to this installation is that when we cold stabilize wine, we can isolate a very small portion of the refrigeration system instead of dropping the temperature down for the entire glycol system," Guffey explains. "Normally we run our glycol at 35°F, but when we cold stabilize we drop to about 18°F. With the separate cold loop, there was a huge kW reduction, especially when there is heavy demand on the system."

The glycol feed pumps have a time clock and a pump controller that allows auto-staging. The lead pump (fitted with a VFD) powers up and down as needed, based on line pressure. The time clock will shut the pumps down at a designated time, slowly turning off the entire refrigeration system.

"When we installed the VFD, timer, and glycol pump auto-stager, we esti-

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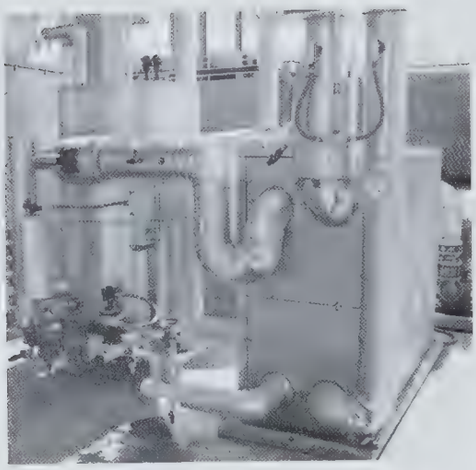

Cold stabilization loop at Courtside includes: chiller in insulated box (right); glycol lines with feed on top and exit at bottom (right side of chiller); refrigerant lines (left side of chiller); insulated glycol tank (at rear); insulated refrigerant expansion tank (front left); one of two 10 hp glycol pumps (back right corner). The separate cold loop adds approximately 100 tons to refrigeration system capacity.

mated energy savings at 135,000 kWh per year, but it is likely higher than that in actual performance," Guffey reports. "It also enables us to shut down the refrigeration system automatically when it makes sense, so I am sure the savings is **much** higher. Total cost of this project was $13,700, and the PG&E incentive was $6,800."

Demand Bidding Program

DBP will credit an incentive to a winery to reduce electric load according to a bid the winery submits when called. Wineries can participate in DBP independently, or as part of a self-aggregated group (a group of facilities that choose to be metered under one account with the utility).

Participating in DPB, a winery will receive notification by noon, one day ahead of a reduction event, and has until 3 PM to submit a load reduction bid via InterAct. PG&E notifies the winery of bid acceptance by 4 PM. The incentive rate is $0.50/kWh for one-day notice. If notified on the day of an event, the winery receives one-hour notice to submit a bid, and an incentive rate of $0.60/kWh.

The winery's bid must be for a minimum of two consecutive hours within the planned event window, and meet a minimum reduction of 50 kW for single sites, or 200 kW for an aggregated group. The winery has to meet 50% of its bid to receive an incentive, and the maximum incentive credit is for 150% of the bid. For each event, a winery can elect to submit a bid or not, and is not penalized if they find themselves unable to reduce demand after submitting a bid.

Courtside Cellars' Demand Response

Courtside experienced no DR events in 2004, but participated in 19 events in 2005, 18 in 2006, and just one event each in 2007 and 2008, which were cooler summers in California.

"We bid pretty low at first when demand events occurred," Guffey says.

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"But since we were now able to monitor our energy use so closely with the InterAct tool, we gained confidence, and we bid more aggressively now that we know what we can achieve."

A typical DR day was July 22, 2006. Courtside was contacted on July 21, made a reduction bid of 1,000 kWh, and achieved 1,136 kWh reduction during the eight-hour event. PG&E credited the winery $160. Since then, incentives have increased. In August 2007, Courtside bid 1,200 kWh, achieved 1,857 kWh and earned a credit of $897.25.

To achieve energy reductions, the winery shuts down all non-essential lighting, stops air compressors, water filtration equipment, and pond aerators, and a personnel check verifies all exterior doors are closed.

"Most of our work is inside, but when employees need to travel outside they have been instructed to close doors behind them, not allowing the hot air to come in. This has been a difficult situation to manage, but now our crew is very conscientious of the issue and does a great job shutting doors behind them when necessary. In several high traffic areas, we have installed automated 'speed doors' to help keep the outside air from influencing the climate inside."

But the greatest reduction is achieved by shutting down the refrigeration systems. "Our building is well-insulated, and we can monitor facility temperatures closely using data-loggers," Guffey explains. "We also check wine temperature in tanks and barrels, and have not experienced any significant or detrimental temperature increases during an event."

Guffey emphasizes that the Demand Bidding Plan is a great fit for the winery because participation is completely voluntary. Courtside can decline if they feel unable to reduce demand because of the winery's workflow, and has chosen not to participate when a demand event day occurred during crush or critical cold-stabilization days.

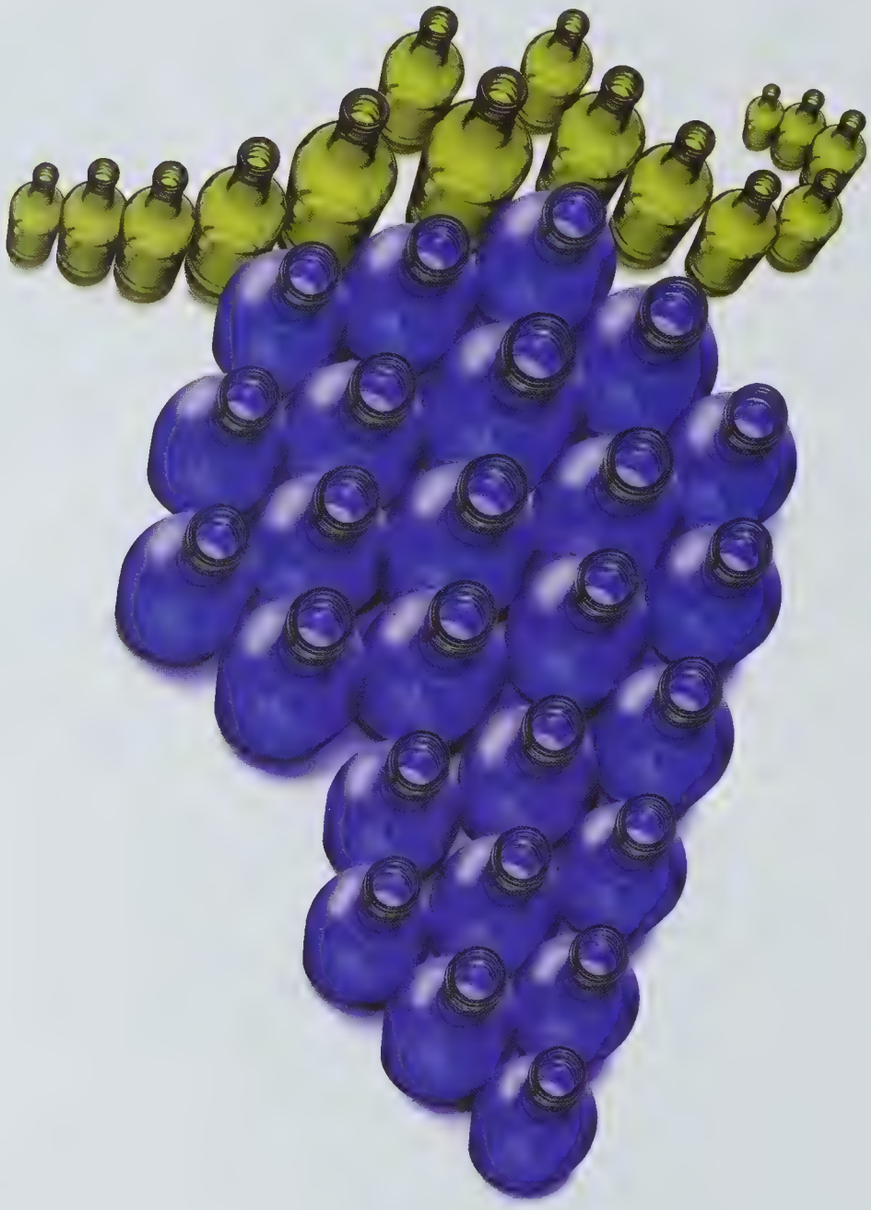
Conclusion

DR can seem like a daunting proposition for a winery, whose product is so dependent on proper storage and temperature monitoring. For wineries who are willing to participate, utility companies offer guidance and support to ensure a program is chosen that fits, and energy use tracking and financial incentives offer strong payback for the risk. For more information on PG&E Energy Efficiency and Demand Response programs visit www.pge. com/agfood.

For detailed information, terms, and conditions of PG&E DR programs, visit http://www.pge.com/demand response. ■

Part II of PWV's coverage of DR programs and participating wineries will appear in the January/February 2010 edition.

Natural Selection.



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How wineries choose packaging

99 percent of vintners use glass packaging for wine. Vintners overwhelmingly prefer glass to alternative packaging materials. Glass is available in a variety of shapes, colors, sizes, and weights. (Photo courtesy of O-I.)

BY Stanley Gossett,
O-I Category Director for Wine

For thousands of years, glass has been the natural container for wine. Unsurpassed in its ability to provide a fresh and lasting product taste, glass has been the overwhelming choice for packaging wine. However, alternative packaging materials are now emerging in the wine industry. Their eventual impact on the market is still unknown.

Market data shows that some consumers are choosing wines that are not packaged in glass. However, many questions about packaging choice are still unanswered. Are bag-in-box, PET bottles, aluminum cans, or multi-layer cartons gaining acceptance from wineries? What benefits does each type of packaging offer, and how do vintners choose between these packaging options?

To answer these key questions, O-I, the world's largest glass container manufacturer, commissioned an in-depth research study polling approximately 150 U.S. winery decision makers. The study, conducted in September and October of 2008, sought to verify key purchase-drivers for wine packaging, measure awareness and perceptions of alternative wine packaging, and determine the strength of positive and negative perceptions of these alternatives.

Of the 150 respondents, approximately 120 represented small wineries (less than 100,000 cases per year) and 30 represented large wineries. The respondents were chosen randomly from an industry list, and the profiles from each revealed slight differences between large and small wineries.

Small wineries tend to provide more premium wine options and are located across the U.S., including the West Coast, East Coast, and Midwest. Large wineries offer more wines at a variety of price points, and are almost exclusively located on the West Coast.

Packaging attributes

While multiple factors contribute to wine packaging purchase decisions, the study found that wineries — both large and small — routinely consider the same packaging characteristics when making a purchase decision.

More than 95% of respondents stated that cost is a major decision factor, and 87% rate this as their number one purchase-driver. Package color was also important to 63% of respondents, due to the UV protection requirements of most wines.

Additional packaging traits given top priority during packaging decisions include whether or not packaging affects the taste of its contents (for 60% of respondents) and whether the packaging affects the product's shelf life (56%). Packaging attributes rated least important by vintners included the weight and transparency of the package.

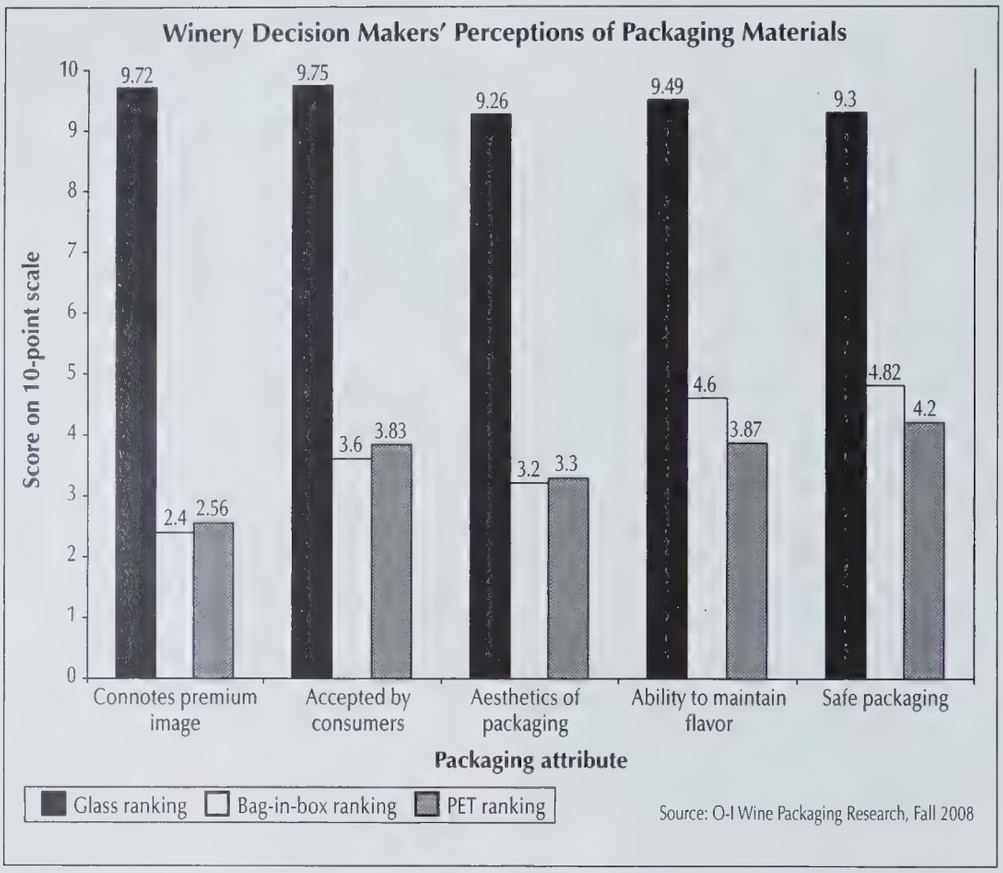
The study did yield interesting differences between small and large wineries. Small wineries tend to place extra value on delivering a premium product, and 71% rank the image of packaging even higher than whether packaging affects the wine taste. Only 48% of large wineries rated packaging image as important.

Large wineries included whether the packaging affects shelf life as one of their top-three priorities. Large wineries are most likely to value how long the packaging can protect and preserve their wines due to the large amounts of wine they produce and ship, especially

Table I: Wineries' Top Three Packaging Purchase Drivers

Rank	Large Winery Respondents	Small Winery Respondents
1	Cost of packaging (83%)	Cost of packaging (91%)
2	Whether packaging affects the taste of the contents (36%)	Image packaging conveys (62%)
3	Whether packaging affects the shelf life of the contents (33%)	Whether packaging affects the taste of the contents (41%)

All wineries purchase based on cost and taste, but small wineries are more concerned with image and large wineries are more concerned with shelf life.



Vintners perceive glass as superior to bag-in-box and PET plastic bottles for most packaging attributes.

because large orders are transported all over the U.S. and beyond.

While the use of environmentally responsible packaging was not in the top three purchase-drivers reported, more than half of all respondents still scored it as a factor when choosing which wine packaging to purchase.

Interestingly, the study showed that larger wineries tend to place more value on sustainability than smaller wineries and are more likely to consider the carbon footprint of a packaging material before making a purchase decision.

Vintners prefer glass

Perceptions can often influence reality, which is why this study also measured vintners' perceptions about wine packaging materials, including glass, bag-in-box, PET plastic, aluminum, and multi-layer cartons. In each category, glass packaging was the vintners' preference. With an average score of 8.3 points (on a 10-point scale) glass packaging was rated an average of 4 points higher than alternative packaging in all 10 categories measured. These categories are included in Table II.

In addition to the preference for glass over alternative packaging in each category, glass was given an average of seven more points (on the same 10-point scale) than bag-in-box and PET packaging for the following categories: premium image, acceptance by consumers, aesthetics of packaging, ability to retain flavor, and safety of packaging.

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Current landscape of wine packaging

While some wineries do offer a mix of packaging options, glass is still the preferred packaging material. Out of nearly 150 surveyed winery decision makers, 99% currently use glass packaging, and approximately 14% use a mix of packaging materials including glass and alternatives. Small wineries are much less likely than large wineries to use alternative packaging (7% vs. 21%).

Of the alternative packaging materials currently used, bag-in-box is the most common, with a 14% utilization rate by wineries. Bag-in-box did not, however, receive high rankings for many of the top purchase-driver categories, including taste of contents, shelf life of contents, and image the packaging conveys. One research respondent noted: "We stopped using bag-in-box because of shelf life and image." Another respondent noted: "[Bag-in-box] may affect the consumer impression of our product."

Table II: Current Packaging Perceptions

	Glass	Alternative Average*	Bag-in-box	PET plastic	Aluminum	Multi-layer aseptic
Accepted by consumers	9.75	3.41	3.61	3.84	3.14	3.06
Connotes a premium image	9.72	2.54	2.41	2.56	2.71	2.47
Ability to maintain flavor	9.49	4.16	4.56	3.87	3.94	4.26
Safe packaging (chemically inert)	9.30	4.35	4.82	4.24	4.17	4.17
Aesthetics of the packaging	9.26	3.28	3.23	3.32	3.38	3.18
Recyclable	8.42	5.07	4.40	5.43	6.44	4.03
Allows you to develop new markets for your product	7.71	4.19	4.56	4.03	4.28	3.88
Strength of packaging	7.54	5.00	4.89	5.10	5.35	4.65
Cost of packaging	6.46	4.35	5.13	4.59	3.49	4.18
Lowers carbon footprint	5.64	4.17	4.52	4.29	3.96	3.89
Average of all attributes	8.34	4.05	4.21	4.13	4.08	3.78

*Attributes were asked for bag-in-box, PET plastic, aluminum and multi-layer aseptic. The four mean ratings were averaged.

On a scale of 1 to 10, with 1 = Not at all Favorable and 10 = Very Favorable, respondents rated glass an average of 4.05 points higher than alternative packaging materials.

Among other packaging alternatives, PET (plastic) was noted by a survey respondent as looking "cheap," and is used by only 10% of large wineries and no small wineries. Only 4% of responding wineries use multi-layer

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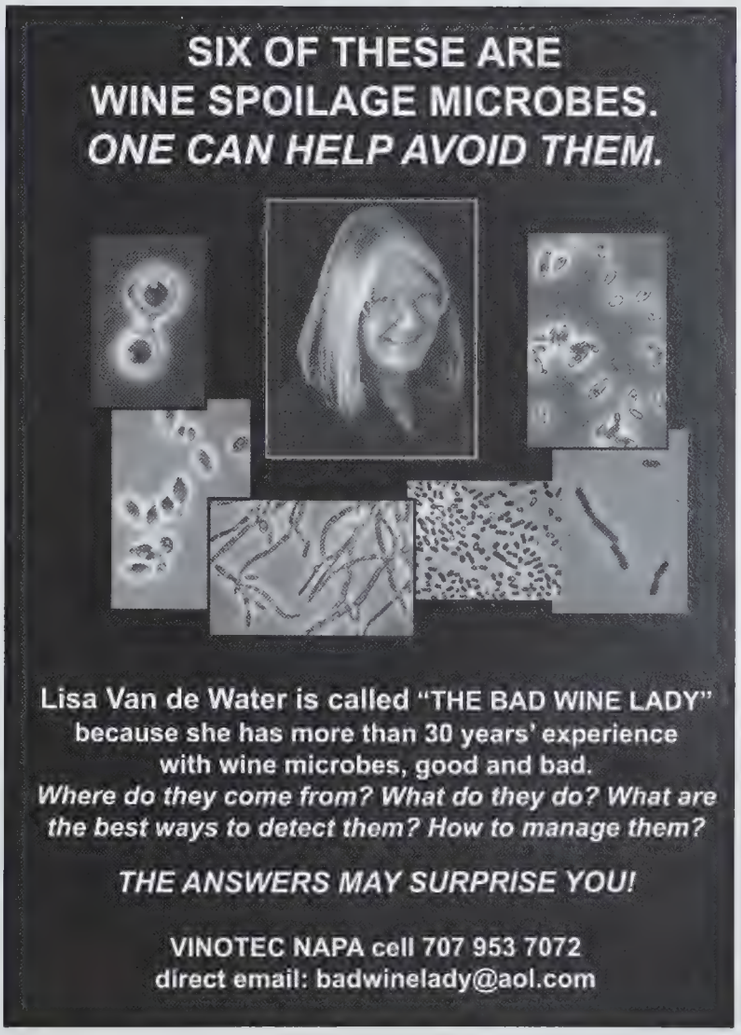
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cartons, and no survey respondents currently use aluminum.

Future of packaging — What is in the mix?

Although glass has a strong lead on alternative packaging materials, approximately 20% of decision makers anticipate changing their packaging mix in the near future. The new mix generally reflects packaging perceptions: 10% are considering using bag-in-box, 9% are looking at PET, 5% may use multi-layer cartons, and 4% may try aluminum.

However, more respondents indicated they would not consider using alternative packaging. Results showed that 72% would never choose aluminum for wine packaging, and 68% would never choose multi-layer cartons. Similarly, 67% of wineries would never fill PET bottles, and 53% would never consider using bag-in-box.

One survey respondent who solely uses glass packaging noted that the price point and costs of manufacturing influence the decision to change to alternative packaging materials. Most wineries are currently equipped with bottling lines for glass packaging, and changes to alternative packaging materials would be costly. Therefore, many wineries may refrain from moving into alternative packaging without a solid understanding of the types of packaging consumers prefer. According to one respondent, "A lot has to do with my perception of what clientele will accept."

In order to demystify consumer packaging preferences for wine, O-I conducted another research study aimed at uncovering the packaging preferences of North American wine-drinking consumers. Results from this study, conducted in April 2009, show that despite the emergence of alternative packaging materials, consumers still overwhelmingly prefer wine packaged in glass. Eighty-six percent of respondents tended to purchase wine in glass most of the time, and 76% of consumers only purchase wine in glass bottles.

If it is not broken, don't fix it

While several packaging options are available to wineries of all sizes, glass is still universally accepted as the most desirable packaging option. O-I is sharing this research with customers and updating its portfolio of stock bottles, including lightweight and ultra-premium options, to meet the preferences of its customers. ■

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2009 WINERY CEO SURVEY

Global recession effects on the wine industry

BY Robert Smiley, PhD, Professor of Management, Director of Wine Studies, UC Davis
Kelly Grogan, Graduate Research Assistant

Seventeen winery CEOs and six other wine industry CEOs participated in an annual phone survey (August 2009) with five questions about the impact of the recession on wine sales by Robert Smiley and Kelly Grogan. Thirteen California wineries included seven in Napa Valley and two in Sonoma County. Two distributors, one bulk wine broker, and one winegrape grower also contributed input. Survey results were presented September 15, 2009 at the Wine Industry Financial Symposium, Napa, CA.

Q What has the impact of the recession been on your business?

• It has been dramatic and noticeable across the board without exceptions. On the wholesale side, I expect we are down 25+%. Retail sales, direct consumer sales, anything with a tax, we are running higher volumes to maintain flat sales to last year. We are working twice as hard to achieve the same sales, and we are noticing that people that were buying six bottles or a case are buying one bottle or two. Wholesale sales, which are down 25%, are 80% of our business.

• Sales are down. It is not universal by wine-item. In the aggregate, on a year-to-date basis, we are down almost 30% on revenue, and the hardest part of the business is high-end wine. Our Sauvignon Blanc is feeling it the least because it is our lowest price wine.

• People are buying lower price wines, and people are eating at home. They are buying wines that they had bought on wine lists but at retail price, so they are feeling a little better about that. Many people have been buying super premium and more expensive wines at the restaurant level, and now that they are eating at home, they enjoying drinking the same wines at a much lower price.

RS: Are you adjusting your inventory levels?

Definitely, during the good times, we were willing to carry more merchandise, and now we have cut back on our purchasing. We are looking for more turns compared to what we did in the past.

• Let us say we were carrying three or four months for certain brands. Now, because of the economy and the need for dollars, we are just working on 60 days on imports and 30 days on domestic wines. We have certain brands that are still too heavy, and we are working our way down.

• We are definitely seeing people going out less and with wine, they are spending less. There is a big trade-down in the wine business on-premise. When you look at spirits, I am not seeing that trading down. My business is off on spirits because people are going out less, but it seems that they are still drinking premium products on the spirits end unlike with wine where I do see a much larger trade-down.

• We have had phone calls from wineries telling us their woes and saying, "We do not even know if we can pay for grapes for 2009." We have had wineries ask us to move the grapes someplace else, and some of them are telling us they are going to pass on the 2009 vintage. It is mostly because of their inventories being controlled by the banks, and the banks tightening the screws.

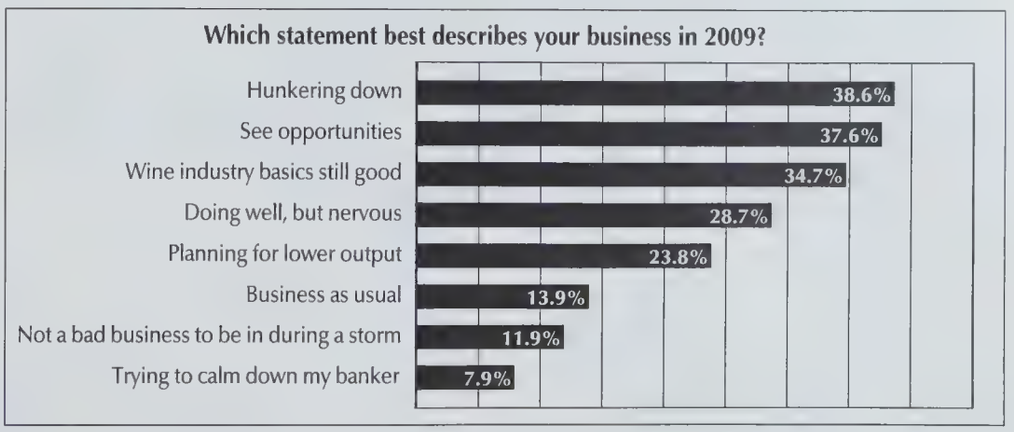
• In fall-2008, we started to see our receivables stretch. We are with the big guys, and we were surprised to see that. That is something we had not experienced before. It continues, and we always have to watch receivables.

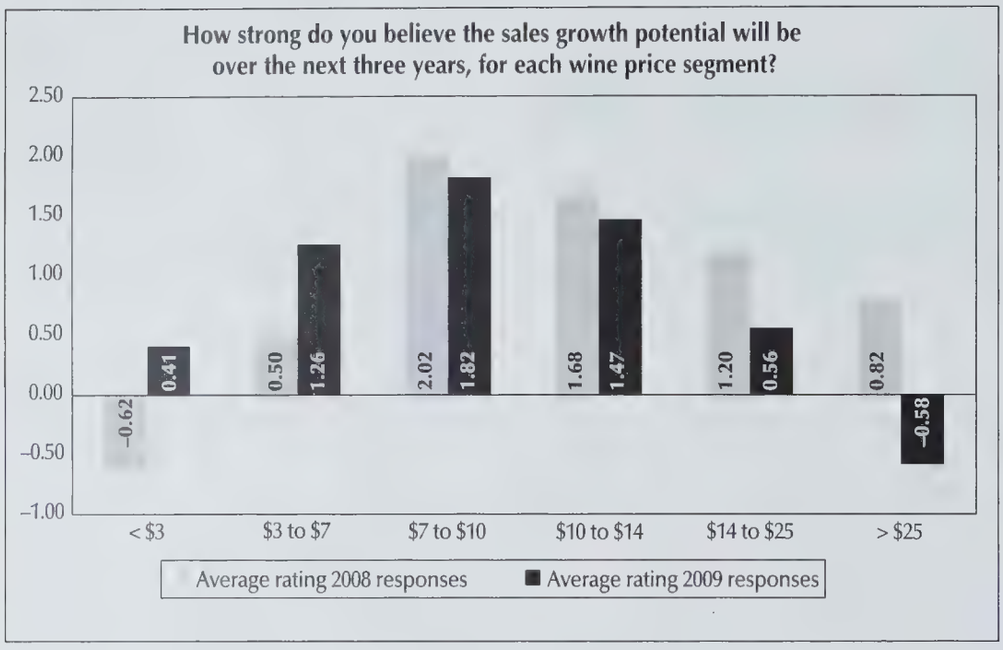
• Many wholesalers are having to renegotiate their banking facilities. Banks are horrific today in terms of lending money because of restrictions and controls. The cost of borrowing is radically different than two years ago.

• Wholesalers and retailers have reduced their days-on-hand stock, and that has had an impact on different things.

• The number of days supply in inventory is probably down 25% in aggregate. We are making some assumptions, but it is probably 2/3 wholesale inventory reduction and 1/3 retail inventory reduction.

• We make most of our sales in the fall, so it is difficult for us to know at this point whether we have been





strongly impacted by the recession. Also, most of our wines are on allocation, so we might not even feel it even though demand might shift substantially. But at this point, we do not feel any impact from the recession.

• The business is challenging. Fortunately for us, we have a number of wine brands that are very popularly priced below $15, and that seems to the direction that a lot of consumers are going today. We are fortunate to have retained and picked up people in that price segment. Unlike a number of companies, we have not had to lay off anyone.

• I found out that, two months after the market collapsed, we started having an increase in sales for all our labels. There seems to be a trade-down going on, and our price-point seems to be in that range. We have made few changes, but we just keep on growing.

• Our business has actually been pretty good. I would not say outstanding, but pretty darn good. We are growing and are continuing to grow. Our $9 to $10 brand is faring pretty well. We do not feel like the economy has hurt too badly in terms of consumer sales.

SUMMARY

❦ Consumers are trading down, and as a result, producers of high-end

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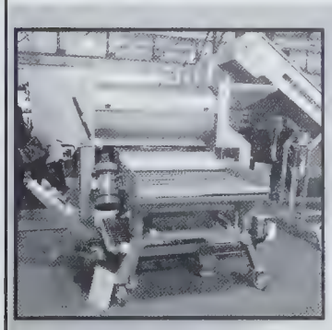

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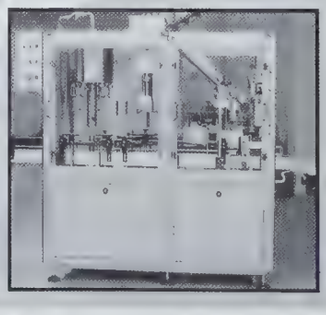

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wine have felt a larger impact of the recession than producers of more moderately-priced wines. Many wine producers at low price-points have actually benefitted from the recession. ❦ Distributors, wholesalers, and retailers are all decreasing their inventories, making it harder for wineries to sell their wine. ❦ Banking restrictions are making borrowing more challenging.

Q What changes have you made to counteract this impact?

I have been in the wine business for 49 years and lived through different business cycles, so it is nothing new to us. We tighten the belt a little bit internally to watch our expenses, and we told our people that they are going to have to work a little harder because it is not peaches and cream out there.

- We have reduced operating costs. We said no cuts in people or salaries, but where else can we find operating savings? We were able to come up with significant cost-cutting on packaging, advertising, and some marketing expenses. We found other costs besides touching grape quality, and we are not having any cuts in people.
- We are being conservative in expenses and cautious about a new grape contract. We are bullish about long-term, but we know that we are going to have a little more inventory at the end of 2009 than what we originally hoped. We are delaying entering into new contracts for one year.
- We have held price. There are more price supports for restaurants, but we have held our retail price. Last year at this time, we were talking about taking the price of our Cabernet up by $10 per bottle, and we finally decided to keep it flat.
- We are going to launch another brand, and a more competitive brand that will be largely driven off of oversupply. But it is positioned so that we can grow it on a sustainable basis going forward, so we will be able to source for this product at an appropriate target margin on a go-forward basis.
- With regard to our current portfolio, we are reaching through different tactics. We have a dedicated representative contacting our top wine club members just making them aware of some specials and dangling some cellar selections, library-type wines, in front of them and that has proved highly effective.
- We are creating deals and pricing concessions as strategically as we can. We are providing whatever support our trade partners need, whether it is more winemaker dinners, more visits, more trade tasting, more account outreach. In the retail room, we are providing enhanced tasting operations, enhanced and extended participation at the winery. I am changing some of

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our retail discount programs. I am giving price-breaks.

• We are putting in place some incentive programs for distributors. We are not discounting aggressively which seems to be a different approach than some luxury-priced wines. Particularly where companies only have high-end priced wine, they tend to be more desperate, and so they are taking desperate actions.

• We are making less wine in the 2009 vintage and discounting the current portfolio by a $1 or $2 retail to put some grease in the system. The thinking is that is the only way you can get them to talk. They just simply do not want to know unless you have got deal-dollars.

SUMMARY

❦ Almost all companies are cutting back on unnecessary expenses and working harder while trying not to cut positions or salaries. ❦ Some wineries are holding price steady to maintain their brand's image, while others have cut prices to stimulate sales. ❦ Wineries are targeting loyal club members and bolstering direct-to-consumer sales. ❦ Many businesses are working with trading partners to provide or request support.

Q When do you think the present market disturbance will end and wine sales will return to pre-recession levels?

• I am of the mindset that consumer behavior has changed, and I am not sure if it will ever go back to the way it was before. This is kind of a sea change for us for the long-term, and when the economy does begin to perform better, I am not sure it is going to be like flipping on a light switch and having the consumer go back to their old ways.

• It has got a long ways to go. The economy is in dire shape. People have changed their buying habits; being very conservative right now.

RS: When the economy picks up again, do you think we will have a permanent change in buying habits?

• Yes, a permanent change in buying habits. People are trying to save money, and they are paying down debts. They are scared about the future.

• It is here forever, and luxury is being re-defined. Luxury wine, high-end luxury north coast wine is being re-defined. Lower perceived value. I believe that people will still trade up. I believe that people still want very high-end stuff, but I believe the bar has been dropped down dramatically, so we will take a very, very gradual pull out over a long period of time, 10+ years, to return to who knows what.

• I am not sure if we are ever going to see the mid-1990s again. I do not ever see that kind of vineyard planting occurring again unless there is some catastrophic disease that wipes out the industry.

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• I would say it is going to be pretty deep. Different than the excess supplies we had in the marketplace. This time we really do not have a lot of extra wine out there, so that helps the industry, and it will help us get out of this faster.

• My opinion is that it is going to be quite a while: two, three, maybe four years. I do not think we have hit bottom yet in terms of both the economy and trading down.

• If you are charging $150 or $250 per bottle, if what you are making is so unique and so fantastic, maybe there will be a market for that kind of wine. But just because your address is Napa or Sonoma or Santa Barbara, you are not going to sell Pinot Noir for $75 per bottle or Cabernet for $150 per bottle unless it is truly outstanding. I do not know if it will go back up.

• Brands that deliver real value and have a real story that supports that luxury-pricing will come back, but these consumers are going to be very much looking for a legitimate value-proposition in that luxury. You have got to be able to justify the price-point other than a façade which maybe you were able to get away with two years ago.

• I hope we start to see a turn as we come close to the holidays and certainly in 2010, but we will see.

• It is funny you ask that question because we had the WSWA young executives here recently, and I asked that question. Their response was, "It will never come back the way it has been." About half of them said that. But they all agreed that it would come back somewhat in three years. I find that a little overly pessimistic. I would say probably 18 months.

• Starting in October, we will no longer be seeing declines over the previous year because the decline happened last October. We think when we review end-of-year results, we will see October to be flat with last year. We might see some improvements over the previous year's numbers.

• You are going to see a lot of wine hit the marketplace in the fourth quarter.

• There are many wineries that are basically pinched for cash-flow. I just know through casual conversations with bankers and people whose opinions I trust and talking to wholesalers. I know how even some of the iconic brands in this industry are performing now. They have all got supply backing up. The reality is that one of the brutal aspects of this industry, unfortunately, and especially on the luxury side of the industry, is that you are holding three vintages at any given moment, and somebody is going to have to take some action to generate some stimulus to create some velocity.

• In fact, third quarter 2008, in September, we had the biggest month we have ever had in our entire history. We were ahead of par, and everything

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was wonderful. Then fourth quarter, bam, it fell off, and I think our business was off over 30%. Then the first quarter 2009, our business was off nearly 30%. Second quarter was 22%. Quarter to quarter. I hope that is a trend.

• As soon as the deal-activity pulls away, and I am guessing it is within the year, we will be stable. I do not know that we are going to be in any kind of growth mode, but my sense is that we will return to profitability, and receive a fair market value for our wine.

• I happen to be in the group that thinks we are getting closer to the end rather than being in the middle of it. I do not buy into the notion that consumers are going to be different forever. They are still going to seek out luxury goods, and I include luxury wine in that. The long-term prognosis for the wine industry is excellent. The per capita wine consumption, as you know, is growing compared to other areas and other cultures.

• You hear people say things like, "I do not know if we will ever see what we used to see," and I think that is stupid. Of course we will. Somebody said to me recently that the consumer is getting used to buying good wine at cheaper prices, and he is never going to go back. Oh yeah, sure, so some of the world's great like Krug Champagne has deals on it. Do you think that someday the customer is not going to go back to paying what he used to have to pay for Krug Champagne if he cannot get it any other way? I think he will go back to it.

SUMMARY

❦ Some people believe that we will never return to pre-recession levels. Consumers have found lower-priced wines they enjoy, and they are now more concerned with value. ❦ Others believe that once the economy recovers, demand for high-end wine will return because people like luxuries. ❦ Many believe only those wineries that deliver true quality and have a story behind them will survive at the high end. ❦ Estimates of when the market disturbance will end range from one year to several years.

Q When we return to a steady state level of sales, what strategic changes do you expect to have made as a result of this recession?

• We added additional sales personnel, and we will retain that, and we always take an aggressive attitude toward sales.

• The most significant parts of it are two-pronged. One will be fewer wines available at retail and at restaurants so that the industry's SKU count will be reduced overall. Many fewer brands will actually reach retail shelves whether it is on- or off-premise. There will also be fewer brands due to the distributors who have weeded out many of their weaker performing products. Essentially we will see some share growth by the more estab-

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lished labels that are authentic, and that is the second prong. The ones who will survive and even thrive once we are through this whitewater will be those wineries and vineyards that have a story to tell.

• We will end up spending more on the new way to market — Facebook and Twitter and more online and more trying to generate interest in the brand in ways we have not tried before. The traditional media is in decline and that includes magazines also. It is going to become a less important place to spend your money, and we are going to have to go online to get those young people. They do not really read these other publications, but there are a lot of people who get their information online.

We have also continued to get closer and closer to the biggest retailers in the U.S. and forge our own closer working relationship, and it is starting to benefit us in a big way. We are trying to make ourselves valuable to them — new ideas, new ways of doing things differently — because distributor consolidation is really a problem, and we have got to be able to fight through it.

• We will probably end up making fewer super high-end luxury wines, probably broadening the pyramid. Probably making more value-priced wines and what I call the new luxury value-priced wines and fewer things north or $80 or $90. Just changing the shape of the product mix we have.

SUMMARY

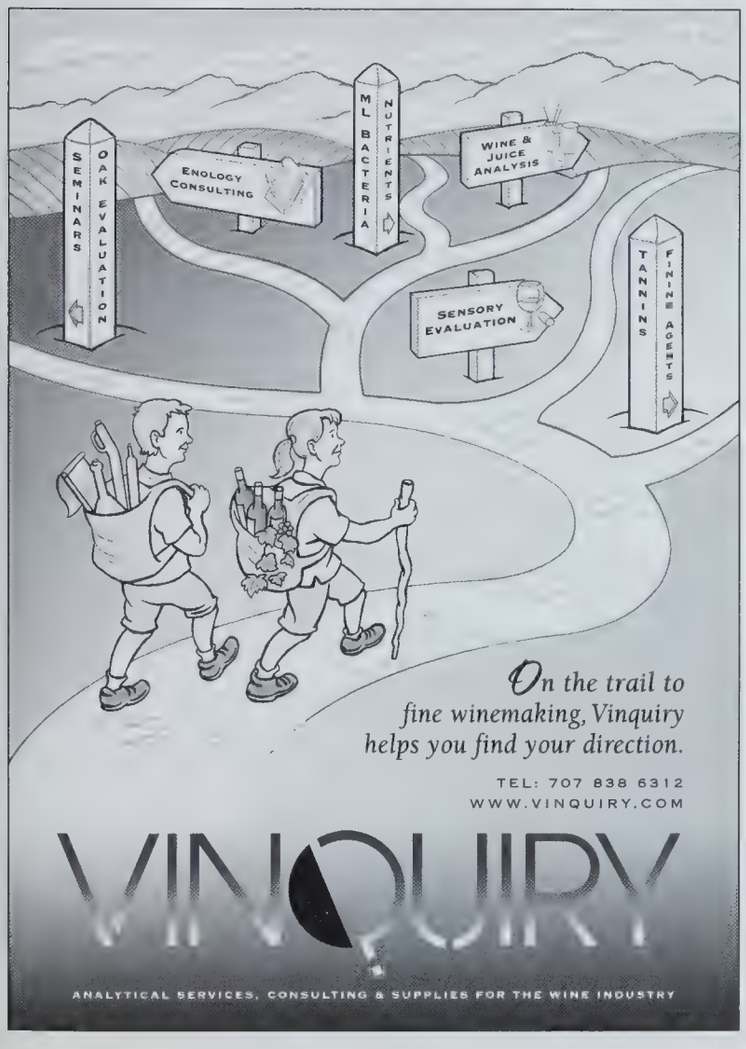
❦ Some companies are moving away from higher end wine to be less vulnerable to trading down. ❦ Some companies are focusing on new ways of marketing and ways to target younger generations who prefer online media to traditional media. ❦ Others are forging better relationships with retailers to move more product through that channel. ❦ Similarly, some companies are increasing their sales personnel to increase sales volumes.

Q What do you think will be the hottest issues over the next five years?

• The American consumer is going to continue what they have been doing the past eight years, and that is experimenting on different labels and wines, not just zeroing in on one brand. That is the way it used to be and they are going to seek variety.

• The wine business will get much stronger. Young people are learning about and enjoying wine. We will be a much bigger wine drinking population, and we will drink more spirits, also. Innovations of new spirits and wine brands and the new world wineries are all adding to a greater industry. California continues to produce better wines at favorable prices, so I think the future is very bright for our industry.

• First of all, when we get into these harder moments, we are quick to think the sky is falling. It is very impor-



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tant to remember that this is just a moment in time. We all are going to have good days and bad days. The economy and the wine business are going to have good years and bad years. We are in a difficult stretch now. Ten years from now, or in the future, there will definitely be brighter moments.

• The premium wine world will be more flat. Wine regions are going to become much more aggressive in competition, and so wine competition, not just imports, will continue to remain fierce and give great product quality opportunities to the consumer. Great winemaking regions will become, not meaningless, but significantly less meaningful than they are now.

• We are going to end up with some level of increased excise taxes. That is automatic; it is just how large they are going to be that is unknown. We are going to continue to buy imports, and imports are going to grow. It will be tough. Our costs here, including land, water, and regulations, are going to continue to go up, and I do not know how much consumers are willing to pay for the wine.

RS: Some people question how well the Central Valley can compete long-term. Do you share that opinion?

No, It is going to be fine. It is going to be all about price-point. If they can grow grapes in the $300/ton range, that is going to be very competitive with imports. Most of the south valley fruit is about $300 to $400. Right now, they can buy cheaper imported wine because of the supply situation, but that is not sustainable.

• Higher taxes. They just instituted a tax in Illinois recently. The sales tax is going to double. The state and federal governments have enormous money pressures, and that is going to be a major problem.

• Everything to do with the environment. We are going to be dealing with thornier issues such as packaging: recyclable and reused packaging. It is going to be bifurcated where inexpensive wines will be more local and more expensive wines will be more strongly skewed towards imports.

• Water is an issue along with sustainability, organic, and how you grow grapes. Once you are able to sell them and get back to normal, then those come back into play. Supply will also be important. We will have to start planting again. This is definitely going to set us back a couple years more. We are not going to see grapes being planted here.

• A lot of that depends upon what my competitors do in the next six months. If competitors drop prices too much, five years out we will basically be battling to raise the prices back up.

• Five years from now, the problem will be grape supply. The reality is we are back where we were, and there is not enough Napa Valley Cabernet to fill the need, and not enough Russian River Pinot Noir to fill the need. The

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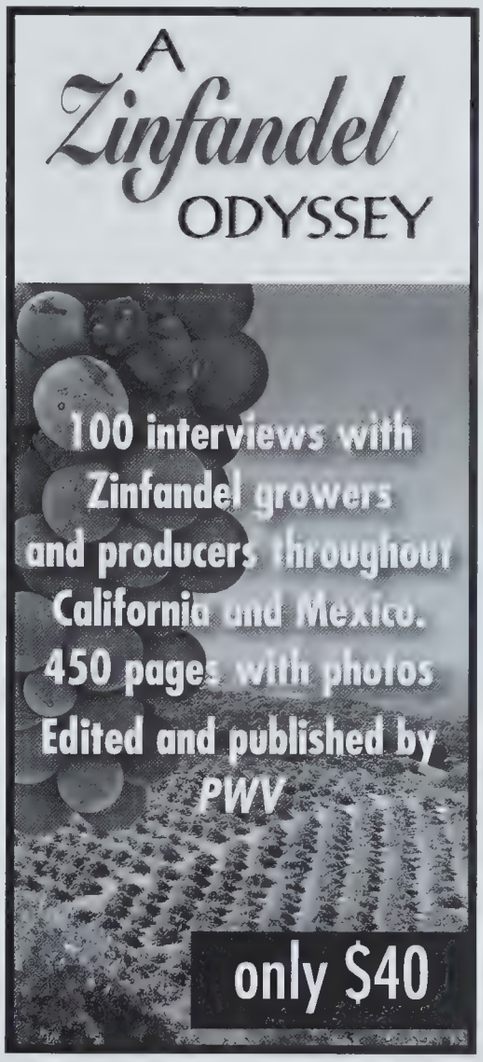
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reality is that the American consumer likes better things, and they like luxuries. As soon as they can afford it, they will rush back and take what they want and satisfy their own pleasures. The brands are going to come back strong.

• I do not know if we are going to see the continued accumulation of $350+ brands in Napa Valley. We will see many of those kinds of brands disappear.

• The San Joaquin Air Quality District is a primary target for the feds because of the poor air quality as a result of just the geographic proximity to the Los Angeles basin, and that has created a place where we are highly scrutinized in terms of our emissions on the fermentation side. This will probably limit our ability at some point down the road. Water use there is another issue. That is everywhere, and those are the things that will probably hold up more planting.

• There are plenty of positives. Wine has become an everyday lifestyle item. People are interested in the health benefits of wine. I really believe that we have great days ahead of us if we are not foolish and hurt ourselves.

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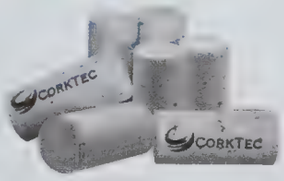

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• Water. Quantity and Quality. You know what is occurring in the southern valley today in the Westlands Water District. Water is going to be huge. It is starting to raise its ugly head up in Sonoma County on when you can or cannot pump along the Russian River. That is going to be huge.

• As long as California is in the financial mess that it is in, excise taxes are going to continue to be an issue.

• The last big thing that I am seeing is the continuing trend of consolidation of the industry. That definitely affects us. It reduces competition, and that has been going on strongly for the last ten years and quite a bit for the last five years.

• The market is going to size itself. I do not know how much consumer market there is for the amount of brands that were launched and continue to be launched out of high valued regions like Napa Valley at over $100 per bottle. I just do not know how much consumer market there is for brands without a really unique selling proposition. There is going to be a vetting there.

• I would not be surprised if Federal Express, UPS, and the like enter the market because it is going to be clear that the 25% to 30% or 50% markup that the distributor takes is going to be a very bright target for freight companies. Most people recognize that these distributors are nothing more than glorified freight companies, and there are guys who are bigger and better operating than them who are going to be able to do it as well.

Summary

❦ Many companies are concerned about increased excise taxes that may result from the state's financial distress. ❦ Quantity and quality of available water may become problematic in future years. ❦ Other environmental issues such as packaging and sustainable production will become more important to the consumer once the economy improves. Air quality regulations may also affected producers in the San Joaquin Valley. ❦ Domestic grapes may be in short supply due to decreased planting caused by the recession and the rising costs of inputs. ❦ Consolidation of the industry continues to be a concern. ■

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SKILLFULLY PLAN STRATEGIES FOR 2010 SUCCESS

BY Hank Salvo, Partner,
Scion Advisors

Approaching the end of 2009 and the 50th National Football League season, the teams that have planned their moves with the most skill are now vying for their place in Super Bowl XLIV, while others have been sidelined. In the wine business, now is also the time for forward-thinking strategy, reviewing your past efforts, and planning for a new winning season in 2010. Your position in the competitive wine market will depend on how skillfully you manage throughout the coming year.

Here are some suggestions to help face the reality of the tough playing field that is the wine market and to help you move ahead of your competitors.

1. *Be lean and mean* — When times get tough you want to keep investing in your core business — what you are known for.

• Address the profitability of peripheral varieties. Prune them when they do not meet your target return or yield a satisfactory return. Or, relegate them to your more profitable consumer direct channel until they are mature enough to survive in the trade.

2. *Go beyond best practices* — Being just as good as your competitors won't cut it during a recession.

• Your customers face new problems, so give them new solutions.

• Create new practices that leapfrog industry best practices in customer care, product value, and quality.

• Make a short list of businesses you admire the most right now: "A players." Ask yourself — why? Adopt some of their ideas.

• Invest in and reinforce what you are best at that also gives you a meaningful competitive advantage.

• Outsource any internal services that do **not** give you meaningful competitive advantage: compliance, winemaking for non-core wines, technology management, bookkeeping.

3. *Reset priorities:* Keep volume and profit forecasts and scenarios current.

• In a rapidly changing economy you have to be nimble and make decisions faster. Stay on top of trends and market performance since it is better to be informed than to be surprised.

• Run worst-case scenarios to determine if you are going to have any inventory or debt covenant issues. Extend those scenarios into next year to see what happens to your grape and inventory requirements, if you are behind on planned volume and profits this year or unsure where you may end up. This may give you an early warning of changes you need to make now to prepare for next year.

4. *Keep it real* — Manage cash flow monthly for the next 24 months.

• Create a realistic cash flow budget that charts both the short term (30 to 60 days) and longer term (one to two years). Schedule timing of payables and receivables and assume you will not be paid as quickly you may have been. Determine where serious cash shortfalls will be long before you are in a "fire drill" mode.

• Monitor, prioritize, and manage all cash disbursements closely. Make sure everyone is staying on budget or, if not, there is an agreed upon reason why not. Use all supplies up totally before repurchase. Be aggressive in moving dollars to where they are needed.

• Bill accurately and collect promptly. To build a better cash position, consider meeting clients halfway on billing disputes — even if your company is not at fault. Become more disciplined in assessing and monitoring customers' credit.

• Contact creditors (vendors, lenders, and landlords) and attempt to negotiate mutually satisfactory arrangements to weather any cash shortages. In some cases, you may be able to arrange better payment terms.

5. *Raise some cash* — Monetize nonperforming assets and hold off spending, smartly.

• Build safety margins in case of unanticipated expenses. I will not presume anyone wants to sell land. However, consider leasing land you are not using — such as bottom land a strawberry farmer might find attractive. Capitalize on excess capacity to custom crush a complementary wine.

• Cash today may be more important than volume next year. Sell bulk wine you do not absolutely need.

• Suspend all capital plans that are not an emergency or will not measurably improve quality for competitive reasons. If you are building a winery, build it in stages as your sales volume increases. Add tanks only as the business justifies it. Rent a bottling line until the revenues are large enough to afford to buy one.

• Do not depend on your banking partners to bail you out of a cash-short situation anytime soon.

6. *Go to market* — *Communicate* like crazy, balancing realism and optimism.

• The impact of face-to-face contact in this environment cannot be understated.

• Make sure your distributors and brokers have volume targets and manage their performance continually. Accountability is critical to success.

Scenario Planning

Businesses that effectively use scenario planning can derive meaningful benefits:

1. A more flexible strategic plan. To manage risks related to investments that extend long into the future, your leadership team must be willing to look ahead and consider many issues. Scenario planning is a tool for helping managers develop multiple views of the future in an uncertain world, manage strategic risks and opportunities, and help create more dynamic plans. While no one scenario will be 100% correct, you will have developed a framework of alternatives that should increase your ability to adapt to your changing environment and manage it more proactively.
2. A more robust, reality-based strategic plan. As an exercise in contingency thinking, scenario planning drives a culture of discipline. The resulting knowledge provides your team with a better understanding of how volume, margins, and costs react, or need to react, in many circumstances.

You will have discussed and quantified how each scenario impacts your business, which could unlock potential changes in your structure that help to streamline costs while supporting growth. After quantifying and refining a variety of possibilities, you can now choose a plan to achieve your company goal. Your final plan may be a combination of different scenarios rather than an initial, single-perspective outlook.

Poor use of the scenario planning tool can lead to trouble. Avoid these traps:

1. Treating scenarios as forecasts rather than a disciplined process of examining possibilities.
2. Constructing a set of too-simplistic scenarios (optimistic and pessimistic).
3. Failing to make scenarios global enough in scope and missing opportunities/threats.
4. Focusing solely on profit or volume scenarios without taking into account Xthe impact ofX how a better utilization of strategic assets may impact your business.
5. Not having an adequate process that engages your leadership team in scenario planning.
6. Not using an experienced and skilled facilitator.

Conclusion

Scenario planning is the process through which winery executives develop and then consider various models of equally plausible futures. The objective is to uncover surprises and unexpected leaps of understanding. When used properly, scenario planning is an effective tool to increase and quantify your knowledge about your business's potential.

Thorough discussions about wine demographics, economic factors, and competition are critical for developing scenarios and their underlying numbers. For that reason, you may find it beneficial to involve outside advisors with a broad wine industry perspective to ask the tough questions that ensure your scenarios are grounded in reality.

7. Cash is not always king — Make judicious investments in technology, infrastructure, and team development.

- While having a strong cash position is critical to surviving a deep recession, making your team stronger through technology or development will pay off.
- Re-evaluate people — and steal some good ones. The right team will improve productivity and accelerate time to results.

Although it is hard to be upbeat in a recession, it can truly be a time of opportunity. **Do not wait to act.** Much depends on how quickly you move, and how well you plan. ■

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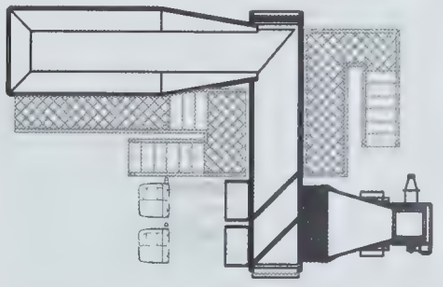

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Effect of serving temperature on sensory attributes of red and white wines

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People have strong preferences concerning the temperature of the foods and beverages they consume. As foods served at different temperatures display different properties, some traditions about serving temperature likely have a sensory basis.[19]

In wine, convention dictates that white wines are typically served at cool temperatures while red wines are presented at room temperature or slightly cooler. The recommended serving temperature range of white wines is between 8° and 12°C (46° and 54°F) and the recommended range for red wines is between 18° and 22°C (64° and 72°F).[10]

Conventional wisdom suggests that the temperature at which a wine is served is thought to affect the intensity of different sensory attributes in wine. Depending on whether the wine is white or red, different taste and mouthfeel attributes are of interest.

In white wine, the typically cooler serving temperature is thought to suppress sweetness while enhancing acidity.

Serving red wine at close to room temperature (rather than cooler) is thought to enhance wine aroma while diminishing the perceived bitterness and astringency typically associated with red wine.[10] While these relationships have been suggested, there is little scientific published research describing the effect of serving temperature on the perception of different wine attributes.

Extensive research has described temperature dependence of the taste system in general. The classic psychophysical study is that of H. Hahn and H. Gunther,[8] who identified threshold values of tastes at different temperatures, with low thresholds indicating that the panelists were able to perceive the attribute of interest at a lower concentration.

The Hahn and Gunther study showed that hydrochloric acid (sour) thresholds were unaffected by temperature. Sodium chloride (salty) thresholds and quinine hydrochloride (bitter) thresholds increased with increasing temperature. Dulcin (an artificial sweetener) showed a minimum threshold at about 34°C (93°F), with the threshold increasing at both the higher and lower temperatures.

B.G. Green and S.P. Frankman demonstrated that cooling both the tongue and taste solutions from 36°C (97°F) to either 28° or 20°C (82° or 68°F) produced measurable reductions in the perceived intensity of sweetness and bitterness.[7] These researchers concluded that the temperature of the tongue was the critical factor affecting bitterness and sweetness perception and suggested that some of the inconsistencies in the taste-temperature literature may be due to lack of control of the temperature of the tongue.

Further studies of sweet perception performed by Green and Frankman, also involving cooling the tongue, have suggested that the receptor mechanism primarily responsible for sweetness perception involves a temperature-sensitive process.[6]

In addition to affecting the perception of different tastes, serving temperature also impacts aroma and flavor perception. Temperature affects the volatility of flavor compounds, depending upon the chemical nature of the compound. Thus, a higher wine serving temperature would enhance the release of aroma compounds from the wine.

The objective of this study was to determine the sensory impact of serving temperature on salient sensory attributes in white and red wines using a trained sensory panel. In white wine, the impact

of serving temperatures of 4°, 10°, and 18°C (39°, 50°, and 64°F) on the sensory attributes of sweetness, acidity, and aroma was examined. In red wine, the impact of serving temperatures of 14°, 18°, and 23°C (57°, 64°, and 73°F) on the sensory attributes of bitterness, astringency, and aroma was examined.

Based on literature reviewed, the hypothesis of this study was that serving temperature does impact sensory properties. In white wine, the serving temperatures examined were hypothesized to affect perceived sweetness, with a smaller effect on perceived sourness. In red wine, the increased serving temperature was hypothesized to increase perceived bitterness and astringency.

Materials and Methods

Subjects: In this study, two separate panels were conducted, one for white and one for red wine evaluations. The white wine trained sensory panel was composed of 12 participants (6 males and 6 females). The red wine sensory panel was composed of 20 participants (9 males and 11 females). All participants were between the ages of 24 and 54. The panelists were wine consumers recruited from the Washington State University/Pullman community.

Panelists were screened for known anosmias and other conditions that may have affected their performance in this panel. A minimum amount of information on the nature of the study was provided in order to reduce potential bias.

For the white wine study, a California white wine was used as the base wine and a Washington State Pinot Grigio (2005) was used as the commercial white wine. A California rosé wine was used as the base wine for the red wine studies. All wines were obtained from a local grocer.

Sensory Panel

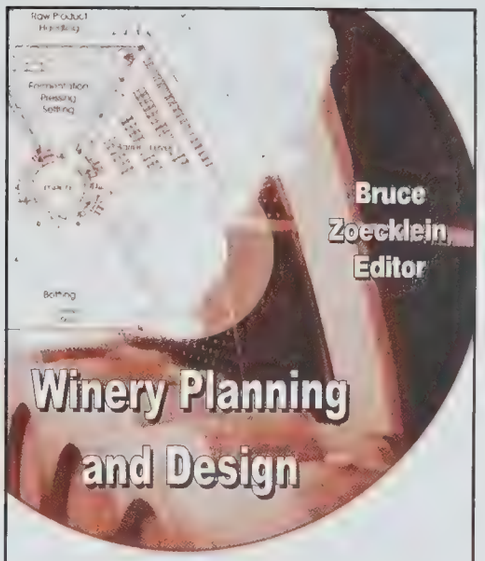
Training: For both white and red wine panels, four one-hour training sessions were held over two weeks. The initial training session involved familiarizing the panelists with the

ABSTRACT — Convention dictates that red wines be served around room temperature (between 18° and 22°C or 64° and 72°F) and white wines be served chilled. The objective of this study was to determine the sensory impact of the serving temperature (4°C or 39°F, 10°C or 50°F, and 18°C or 64°F) of white wine and serving temperature (14°C or 57°F, 18°C or 64°F, and 23°C or 73°F) of red wine on wine sensory attributes. A trained panel evaluated a series of adjusted model wines served at the above temperatures.

These temperatures represent the range of temperatures that were suggested on various sources. For the red wine, room temperature (23°C) represents the highest temperature a red wine would be served, with 14° at the very low end. For the white wine, 4° is the coldest that white wine would be served (refrigerator), with 18° on the high end. Wine at room temperature was achieved by allowing a wine to equilibrate at room temperature for 24 hours prior to evaluation.

The control wine is wine with nothing added to it (plain base wine). The model wines are the control wines (or base wine) with compounds added to adjust sweetness, acidity, bitterness or astringency. The control white wine was adjusted to enhance sweetness and acidity while the control red wine was adjusted to enhance bitterness and astringency. For both wines, the adjusted wine was rated significantly higher on the enhanced sensory attribute compared to the unaltered control.

In white wine, serving temperature significantly affected perceived aroma, with sweetness and acidity intensities impacted by the interaction between panelist and temperature (p less than 0.05). In red wine, serving temperature significantly affected aroma intensity. These results indicate that the sensory attributes of white wines may be more influenced by serving temperature than those of red wines when the wines were presented within a range of typical serving temperatures within their respective types (red and white).



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sensations of sourness and sweetness, using solutions of 15 g sucrose/L and 2 g citric acid/L, respectively. During subsequent white wine training, the sucrose concentrations that were added to the base wine as reference standards were 15 g sucrose/L (low sweetness) and 25 g sucrose/L (high sweetness). For acidity training, citric acid standards were prepared in base wine at 1 g/L (low acidity) and 2 g/L (high acidity).

Combinations of these concentrations of sucrose and citric acid were also presented to the panelists. During the early training sessions, the solutions were presented at room temperature, but as training progressed, solutions were served at different temperatures (4°, 10°, and 18°C or 39°, 50°, and 64°F).

For red wine training sessions, reference standards of bitterness and astringency were prepared in base wine in order to familiarize the panelists with these tastes (concentrations below). The distinction between bitterness (a taste sensation) and astringency was made, with astringency being defined as the tactile sensation imparting a mouthfeel of drying, roughing, or puckering. Bitterness was defined as the taste sensation most intensely, but not exclusively, felt at the back of the tongue.

Astringency reference standards were prepared through the addition of 1.3 g tannic acid per L (low astringency) and 2.6 g tannic acid per L (high astringency) to the base wine. For bitterness training, quinine sulfate standards were prepared in base wine at 13 mg/L (low bitterness) and 50 mg per L (high bitterness). Combinations of these concentrations of tannic acid and quinine sulfate were also presented to the panelists.

Figure 1. Water baths used to maintain serving temperatures of white and red wines.

During the early training sessions, the solutions were presented at room temperature, but as training progressed, solutions were served at different temperatures (10°, 14°, 18°, and 23°C or 50°, 57°, 64°, and 73°F).

Aroma intensity reference solutions were prepared using diluted wine (two parts water to one part wine) for low aroma intensity and undiluted wine for moderate- to high aroma intensity. During these training sessions, a 15-cm line scale was used, anchored by the terms "low" and "high" at 1 cm and 14 cm, respectively.

Sensory testing: All ISO/INAO wine glasses were held at room temperature until pouring. Immediately prior to serving, 30 mL aliquots were poured into coded wine glasses and covered to retain volatile compounds. Following pouring, these samples were served immediately to panelists. Panelists were instructed to hold the wine glass by the stem so as not to impact the temperature of the wine.

Treatments were presented in random order. All test sessions were conducted in the sensory laboratory under white lights. The sensory evaluation for each wine treatment and serving temperature was replicated twice, with replicate tests performed on different days.

For white wine evaluations, panelists were asked to rate the intensity of the wine aroma, sweetness, and acidity sourness on a 15-cm line scale as described above.

For red wine evaluations, panelists were asked to rate the intensity of wine aroma, astringency, and bitterness on a 15-cm line scale as described above. Each panelist was provided with deionized filtered water and unsalted crackers for cleansing the palate.

White wine treatments used for the final evaluations were an untreated control wine, wine + acid (control + 2.0 g citric acid per L), wine + sucrose (control + 25 g sucrose per L), wine + acid + sucrose (control + 2.0 g/L citric acid + 25 g sucrose per L), and Pinot Grigio (2005). All treatments were held at controlled temperatures of 4°, 10°, and 18°C (39°, 50°, and 64°F) in refrigerated water baths.

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Red wine treatments used for the final evaluations were untreated control wine, wine + astringent (control + 2 g tannic acid per L), wine + bitter (control + 40 mg quinine sulfate/L) and wine + astringent + bitter (control + 2 g tannic acid per L + 40 mg quinine sulfate/L). All treatments were held at controlled temperatures of 14° and 18°C (57° and 64°F) in refrigerated water baths or at 23°C (73°F) ambient room temperature.

Chemical analysis: White wines were equilibrated to room temperature before analysis. Titratable acidity and pH were measured according to the procedures of Amerine and Ough.[1] Wines were titrated with 0.1 N sodium hydroxide to end point 8.4 using a Titroline Easy autotitrator (Schott Instruments GmbH, Mainz, Germany).

Percent titratable acidity was calculated as tartaric and citric equivalent. °Brix was determined using a hand-held refractometer (Pocket PAL-1, Atago U.S.A., Bellevue, WA). Titratable acidity, pH and °Brix were also determined for the white wines at each specific serving temperature. The red wines were analyzed for tannin concentration using the assay developed by J. Harbertson et al.[9]

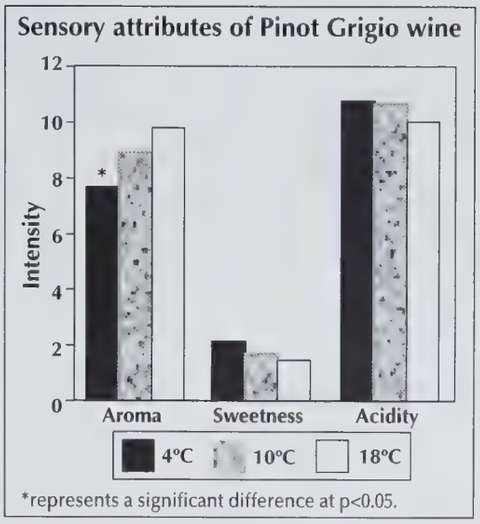

Figure II. Serving temperature effect on sensory attributes of white wine.

Statistical analysis: Data were analyzed using SAS PROC GLM for Windows 9.1 (Cary, NC). Analysis of variance (ANOVA) was applied to the entire data set to determine which of the experimental variables (judge, temperature, treatment, rep) were significant sources of variability. Significance was defined as p less than 0.05. Separation of the means was accomplished using Fisher's Least Significant Difference (LSD). Principal Components Analysis (PCA) was performed using XLSTAT (Addinsoft, Paris, France).

Results

Chemical analysis: Results of the chemical analysis of the adjusted model white wines and commercial Pinot Grigio are shown in Table I. The results demonstrate the differences in composition of the adjusted model white wines. Titratable acidity (TA) was calculated both on the basis of tartaric and citric acid, as the acidity in the model wine was adjusted using citric acid.

Results showed that the control wine and the wine + sucrose were significantly lower in TA than the commercial Pinot Grigio, the wine + acid + sucrose, or the wine + acid. The pH levels among the wines were also significantly different, with the wine + acid and wine + acid + sucrose having the lowest pH levels and the commercial Pinot Grigio having the highest pH.

The control wine had the lowest °Brix while the wine + sucrose and the wine + acid + sucrose had the highest °Brix levels. Table II shows the impact of serving temperature on the chemical parameters of TA, pH, and °Brix in the adjusted model wines. As serving tem-

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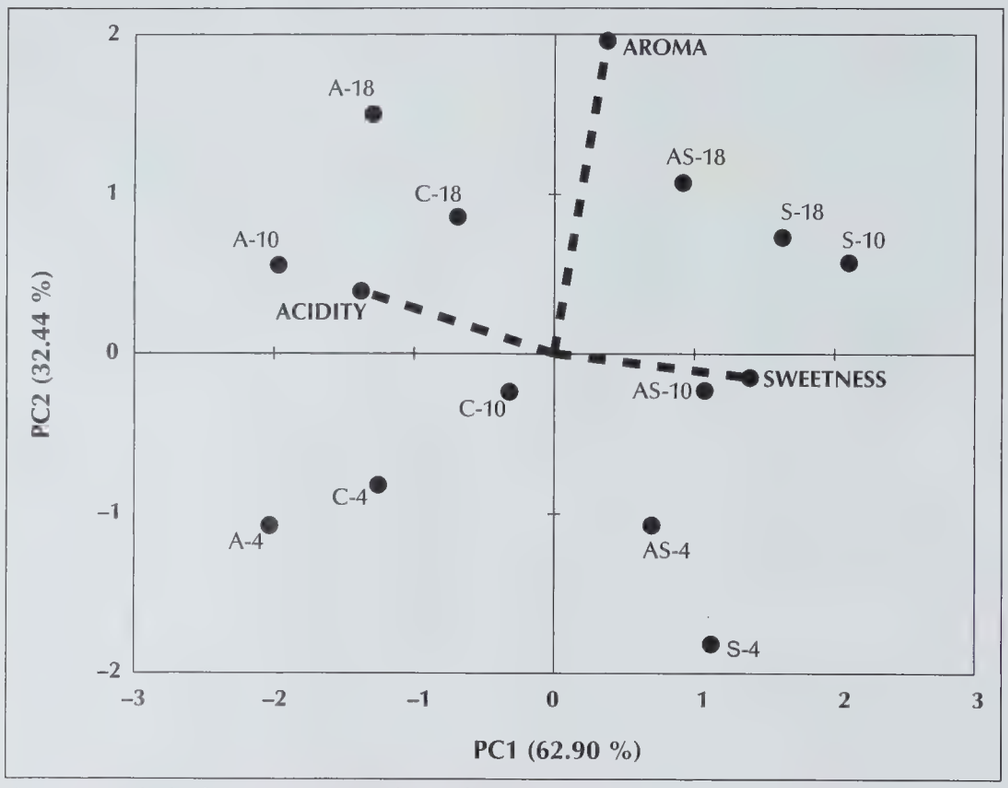

Figure III. Principal Components Analysis of adjusted white wines served at different serving temperatures. (C = control, A = acid, S = sweet, AS = acid+sweet)

perature increased, TA increased while pH decreased.

The chemical analyses of the red wines are shown in Table III. The control wine was found to be significantly lower in tannin concentration than the wine + tannic acid and the wine + tannic acid + quinine sulfate (QS) (p less than 0.05).

Sensory evaluation: The treatment effects on the sensory attributes of white wine are shown in Figure I. In aroma perception, no significant differences were noted between the adjusted model wines. With perceived sweetness, the untreated control wine was perceived as significantly sweeter than the wine + acid and significantly less sweet than the wine + sucrose and wine + acid + sucrose. No significant differences were noted between the wine + sucrose and the wine + sucrose + acid.

In evaluating acidity in the adjusted white wines, panelists noted significant differences. The least acidic wine was the wine + sucrose, while the wine + acid was perceived as the most acidic (p less than 0.05). The wine + acid treatment was significantly more acidic than the wine + acid + sucrose treatment, indicating that with the addition of sucrose, perceived acidity was suppressed.

In mixtures of substances with different taste qualities, the components can still be recognized, but are usually perceived as less intense than when unmixed. All four classical taste qualities are thought to exhibit this inhibitory pattern, referred to as mixture suppression.

Results of similar magnitude were found in the present study (Figure I). The perception of sweetness (wine + sucrose) was not significantly suppressed with the addition of acid (wine + sucrose + acid). However, with perceived acidity, the wine + acid was perceived as significantly more acidic than the wine + acid + sucrose, indicating the suppressing effect of sucrose. These results were similar to those of L.M. Bartoshuk et al.[4]

Analysis of variance results for the model white wines are shown in Table IV. Treatment (addition of sucrose, acid, or both) had a significant effect on perceived sweetness and acidity but not on perceived aroma. As none of the model wines were adjusted so as to affect aroma intensity, this result was expected. The observed treatment effect indicated that the training the panelists received was adequate, as they were able to perceive differences between adjusted model wines.

Serving temperature affected perceived aroma intensity (p less than 0.05), but did not significantly impact perceived sweetness or acidity. Individual variation was reflected in the

significant panelist effect observed for all sensory attributes tested (p less than 0.05). Previous studies with highly trained panels have also shown such individual variation due to differences in scale usage.[5]

Interactions between several main effects also produced sources of variation. The significant interaction between panelist and treatment for aroma, sweetness, and acidity ratings indicate that these ratings varied depending upon the panelist.

There was also a significant interaction between panelist and serving temperature for sweetness and acidity, indicating that temperature did impact perception of acidity and sweetness but this impact was dependent upon the panelist. For aroma, the interaction between panelist and treatment was significant; however, no interactions between panelist and treatment or treatment and temperature were observed.

A commercial Pinot Grigio was included in the white wine serving temperature study (Table V). Serving temperature significantly affected the perception of aroma, but not sweetness or acidity. A significant panelist-effect was found for perceived aroma and acidity (p less than 0.05). These results are similar to those found for the model white wines. Sweetness was not significantly impacted by any factor, indicating the agreement between panelists on the low sweetness rating of the wine as observed in Figure III.

In white wine, serving temperature significantly affected perceived aroma intensity (Figure II). The aroma intensity was significantly different at all three serving temperatures for the adjusted model white wines, with wine at 4°C (39°F) having the lowest perceived aroma and wine at 18°C (64°F) having the most perceived aroma. Sweetness and acidity of the model wines were not significantly affected by serving temperature.

The higher serving temperature of the wine (18°C [64°F]) was expected to enhance the aroma of the wine as, generally, aromatic compounds become more volatile with an increase in temperature. In addition, the temperature range used in this white wine study (4° to 18°C or 39° to 64°F) and the broad definition of aroma intensity used in the study were expected to increase aroma perception.

The effect of serving temperature on the sensory properties of commercial Pinot Grigio was similar, as observed in the model wines (Figure III). Serving temperature did not sig-

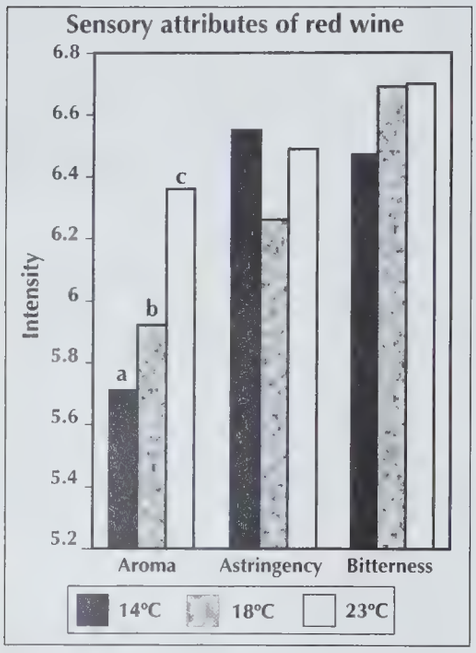

Figure IV. Serving temperature effect on sensory attributes of red wine. Different letters (a, b, c) within the same attribute represent significant differences between serving temperatures.

nificantly affect panelist perception of sweetness and acidity, but wine served at 4°C (39°F) had significantly less intense aroma compared to the other two serving temperatures. The sweetness and acidity of commercial Pinot Grigio was rated similarly to wine + acid.

In the PCA (Figure IV), the first two principal components (PC-1 and PC-2) explained 96.66% of the cumulative variance. Generally, the separation of the same treatments at different temperatures was along perceived aroma. The wines adjusted with sucrose were clustered together in Figure IV and were separated based on perceived sweetness. Wine + acid samples were clustered together and were separated primarily based on perceived acidity.

The separation of wine + acid and wine + acid + sucrose on the attribute of perceived acidity supported the idea of sucrose suppression of acidity. Commercial white wines were primarily separated from the other samples based on their acidity and aroma. These wines were rated low in sweetness (see Figure III).

In Figure V, the effects of treatment on attribute perception in red wine are shown. No differences in perceived aroma were found. Differences in astringency were found, with the control wine and wine + QS perceived as significantly less astringent than the wine + tannic acid and the wine + tannic acid + QS (p less than 0.05).

The wine + tannic acid and wine + tannic acid + QS were not perceived as significantly different in astringency from each other. These results indicate that panelists were able to discern astringency, even in the presence of a bitter compound. The lack of interaction between panelist and temperature indicated that in general, panelists were not influenced by serving temperature.

Bitterness was perceived as significantly different among all of the treatments. The control wine was perceived as the lowest in bitterness and the wine + tannic acid + QS was perceived as the most bitter. Previous studies have shown that bitterness and astringency may be confused with each other.[14]

In the present study, while panelists rated the wine + tannic acid as significantly more bitter than the control wine, the panelists did rate the wine + QS sample significantly higher in bitterness compared to the wine + tannic acid sample. These results seem to suggest that the panelists were not confusing bitterness and astringency, but rather that the tannic acid imparted a bitter sensation to the adjusted wine.

Tannic acid, the compound added to the model wine to enhance astringency, has been described as having both bitter and astringent characteristics. According to scalar ratings in a previous study, both perceived astringency and bitterness increased as a function of tannic acid concentration.[16] S. Kielhorn and J. Thorngate also reported that tannic acid has both astringent and bitter properties.[11]

The red wine panel analysis of variance results are shown in Table VI. Treatment did not have a significant effect on aroma intensity, but significantly affected perceived astringency and bitterness (p less than 0.05). This result was expected, as none of the treatments manipulated aroma intensity, while they did manipulate bitterness and astringency. Serving temperature significantly affected perceived aroma, but not perceived astringency or bitterness.

The significant impact of panelists on all attributes indicated the individual variation between panelists, a

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result similar to that found in the bitterness and astringency evaluation of grape seed phenolics by R. A. Arnold and A. Noble.[3] For perceived astringency and bitterness, significant interactions between panelist and treatment were observed (p less than 0.05), indicating that even with the training, several panelists did not use the scale consistently.

Serving temperature had a significant impact on aroma intensity, with a lower aroma intensity perceived at 4°C (39°F) than at 23°C (73°F), as seen in Figure VI. No differences in perceived astringency or bitterness were observed for any of the other serving temperatures. In studying the temperature dependency of taste intensity, H. Moskowitz reported that bitterness did not exhibit temperature dependency over the temperature range of 25° to 50°C (77° to 122°F).[15]

Another study examined seven salient sensory qualities of reduced-sodium soups served at different temperatures.[16] Results showed that while soups served at 22°C (72°F) were perceived as saltier than those served at 65°C (149°F), bitterness was not affected by serving temperature.

Principal components analysis of the adjusted red wines served at different temperatures is shown in Figure VII. The total cumulative variance explained by these components is 87.19%. The control red wine was separated by the other samples on its low perceived bitterness and astringency.

However, as the temperature of the samples increased, the samples spread out with increased perceived aroma. The wine + QS sample was defined by its bitterness, with this being rated higher in aroma when served at 23°C (73°F). Wine + tannic acid was separated on its perceived astringency and wine + QS + tannic acid was also separated by its attributes.

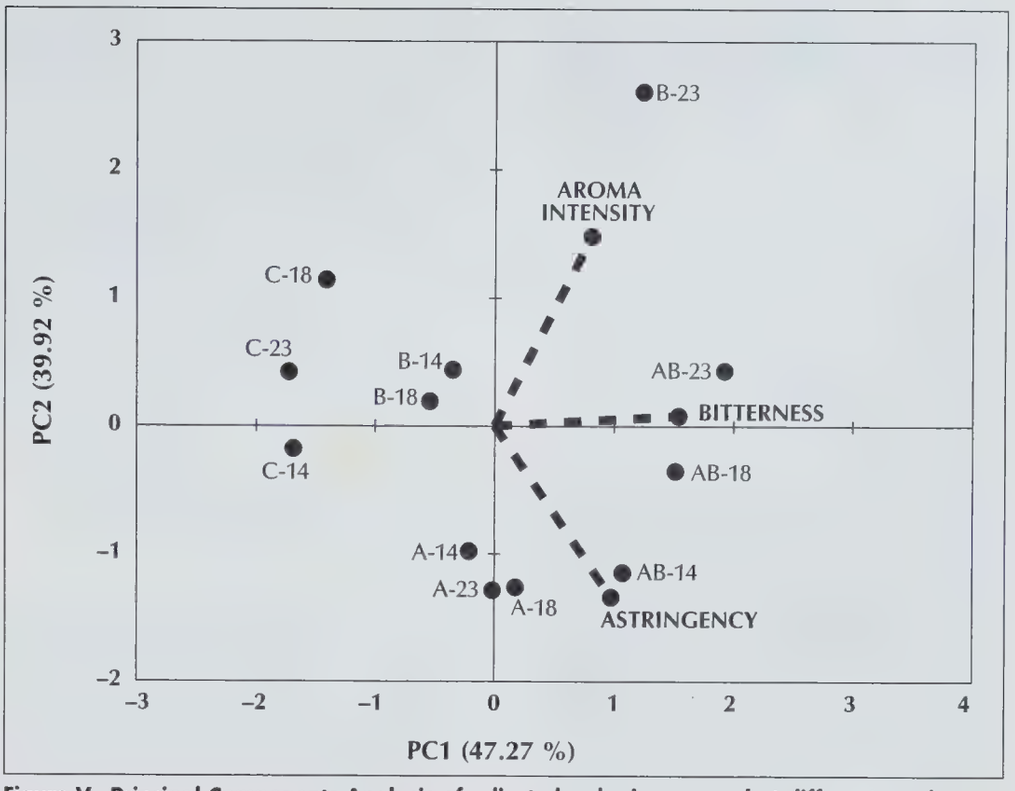

Figure V. Principal Components Analysis of adjusted red wines served at different serving temperatures. (C = control wine, A = astringent, B = bitter, AB = bitter+astringent)

Context effect, a bias in which panelists contrast sensory events with their surrounding context, may have had an influence in this study.[13] Stimuli are viewed as weaker in a stronger context and stronger in a weaker context.[12]

For example, after exposure to a wine + sucrose sample, the acidity of the wine + acid sample may have seemed especially high. To minimize the context effect, samples were presented in random serving order. In addition, carryover may have been a factor between samples as astringency tends to build over time.[2] However, the panelists used a palate-cleanser and water to help minimize this effect.[17]

Conclusions

The effect of serving temperature on the sensory attributes of red and white

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wine was examined in this study. In white wine, as serving temperature decreased, overall aroma intensity also decreased.

Sweetness and acidity intensities were significantly influenced by the interaction between panelist and temperature. In red wine, serving temperature significantly impacted aroma intensity but did not affect the perception of bitterness or astringency. This supports previous research, which showed that bitterness is not as affected by temperature as acidity or sweetness.

These results indicate that as perceived by this trained panel, the sensory attributes of white wines may be more influenced by serving temperature than those of red wines. Perhaps serving temperature of wine is more dictated by convention rather than sensory considerations. ■

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Pyrometer used to assure wine quality

BY Kristy Charles / Joe Webb,
Foursight Wines,
Boonville, CA

Early in 2008, my husband, winemaker Joe Webb, and I were in a Sonoma County, CA restaurant and ordered a bottle of Pinot Noir. It arrived at the table slightly warm — alarming us both. We decided to give the restaurant, which had a good reputation, the benefit of the doubt and ordered an ice bucket to chill the wine slightly. The server, upon hearing our request, replied, "I'm sorry, but you don't chill red wines." We ordered the ice bucket anyway.

The idea that there must be a tool available to easily measure the temperature of any wine bottle took root in Joe's mind after that dinner. In May 2008, flipping through an automotive parts catalog, he found that tool: a pyrometer. He ordered it immediately and, in the following weeks, we experimented with the temperature of our Foursight wines. We discovered the optimal temperature range for our Sauvignon Blanc is 55 to 58°F, and our Pinot Noir shows best at 65 to 68°F.

A few weeks later, we suffered through the hottest Anderson Valley Pinot Noir Festival on record. It was 105°F outside (and likely 115°F in the tent) and everyone's Pinot Noirs were measuring about 90°F on their tables. Having the pyrometer on-hand enabled us to monitor the temperature of our bottles and rotate them through an ice bucket as needed, thus keeping them between 65 to 68°F constantly.

As a brand new winery in 2008, this allowed us to make our very best presentation, even when neighboring wineries' wines continued to heat up throughout the afternoon. By mid-afternoon, our table was absolutely packed, which I attribute not only to the quality of the wines, but also to our ability to control the quality of the product that we poured, via the pyrometer.

We use the pyrometer at every event we attend, and in our new Boonville, CA tasting room. We can check our wine refrigerator to ensure it is running properly, and to know to pull the Sauvignon Blanc out of an ice bucket when it dips below 55°F. It has been a fantastic tool that we use daily and that we get a lot of questions about, both from consumers and fellow vintners.

I would imagine it is only a matter of time before we see pyrometers in use at most wineries, and why not? They are inexpensive, and easy to use.

We use a $60 pyrometer in our tasting room that is not a lot of money for how much we use it (daily). We also have a smaller, less expensive ($16.50) Spark Industries Micro Temp Digital Infrared Pyrometer, that we take with us when traveling to tastings off-site, although not quite as accurate as the larger, more expensive model. I think the smaller version would work for most wineries! ■

Photo by Gabriela Hasbun

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Friday, January 29, 2010
High Elevation/ High Latitude Seminar
Unified Symposium, January 26–28, 2010
Sacramento Convention Center, Sacramento, CA

Cooler climates and higher elevations are attracting winegrape growers and winemakers as never before. The 2010 Unified Wine & Grape Symposium's *High Elevation/High Latitude Seminar: Wine Growing On the Edge* will review the challenges and rewards for those who choose to tread where few others have before them.

"We want to showcase the uniqueness of the wines coming from these regions," says Glenn McGourty (UC Cooperative Extension viticulture advisor for Mendocino and Lake counties), seminar coordinator. "There is an old quote, 'On the edge of adaptation you will find brilliance.' As our industry continues to focus on terroir, interest in the style and quality of the wines coming from these regions has never been greater."

Speakers from several countries will give presentations, including Vittorino Novello, Professor of Viticulture, University of Torino, Piemonte, Italy, and Pat Bowen, Pacific Agri-Food Research Center, Okanagan, Canada. Specific high elevation/high latitude regions, such as the Sierra Foothills, Lake County, coastal California, Washington, Argentina, and New Zealand, will be examined.

"Seminar attendees will gain a broad knowledge of the challenges of growing and making wines in these special regions," adds McGourty. "They will also learn about the flavors and quality that people are obtaining from these regions and what makes them truly reflective of their unique terroirs."

The Unified Wine & Grape Symposium, which takes place at the Sacramento Convention Center in Sacramento, Jan. 26-29, is jointly hosted by the American Society for Enology and Viticulture (ASEV) and the California Association of Winegrape Growers (CAWG). It includes three days of program sessions devoted to topics in the areas of: Grapegrowing; Winemaking; Business, Economics and Operations; and Marketing and Public Relations.

Built with the joint input of growers, vintners, and allied industry members, the Unified Symposium is an annual clearinghouse of information important to wine and grape industry professionals along with the industry's largest trade show, with more than 550 vendors displaying products and services. For additional information, please call 530/753-1342 or visit www.unifiedsymposium.org.

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March 24–28, 2010
INTERVITIS INTERFRUCTA Trade Fair
Stuttgart, Germany

"Architecture is an important building block of corporate design," explains Freidrich Lörcher, Head of Marketing at the state teaching and testing institute for viticulture and fruit cultivation in Weinsberg, Germany. "If functional buildings are upgraded to symbols, then architecture becomes 'corporate architecture,' which emphasizes the uniqueness and capability of a company to the customer."

INTERVITIS INTERFRUCTA 2010 is keeping up with these changes. At the international technology trade fair for wine, fruit, fruit juice and spirits, the German "Wine Architecture Award" will be presented for the second time.

"The context of form and materials, the interplay of color and light, the appeal of old and new develop in wine shops and wine tasting rooms, the charm and distinctive character of a wine estate in a cellar," explains Hendrik Hering, Minister for Economics, Transport, Agriculture, and Viniculture in the Rhineland-Palatinate.

Submissions included exemplary complexes for wine estates and winegrowing businesses, buildings for enology and wine production, wine shops and buildings for gastronomy and accommodation. Only projects completed after January 1, 2004 will be considered. In addition to new buildings, applications were permitted that had been renovated, redeveloped, converted or preserved as historic buildings.

"The theme of wine and architecture at INTERVITIS will be an important thematic building block of the 60th German Viticulture Congress," says DWV General Secretary Dr. Rudolf Nickenig. "Speakers will examine, in theory and in practice, what modern winegrowing architecture looks like, which building styles and materials are suited to a certain company, and how current knowledge from the areas of building biology, and energy and recycling management, can be usefully implemented."

In Hall 7 of the new Stuttgart Trade Fair Centre, interested winegrowers will have the chance to speak to industry experts at the *Wein baut* trade fair stand (wine growing and building), created especially for INTERVITIS INTERFRUCTA.

INTERVITIS INTERFRUCTA will take place for the first time at the new Stuttgart Trade Fair Centre next to the Stuttgart airport. Visitors from all over the world will be able to discuss the latest machines, equipment, and services for winegrowers, fruit farmers, distillers and fruit juice manufacturers, with approximately 600 exhibitors coming from more than 30 countries.

The INTERVITIS program will be divided into four areas: Cultivation and Harvesting Technology for Grapes and Fruit, Processing and Process Control for Wine, Fruit Juice and Spirits, Filling and Packaging Technology, and Marketing and Organization.

INTERVITIS INTERFRUCTA 2010 will take place immediately before the ProWein wine trading fair in Düsseldorf (March 21–23). For more information, visit cms.messe-stuttgart.de/cms/intervitis10_blick.0.html?&L=1.

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Artisan Barrels

Since 1997, Artisan Barrels has been offering winemakers a one-stop shop for top quality, well-constructed barrels and wooden, concrete, and stainless steel wine tanks, from several Artisan coopers in Burgundy, Bordeaux, Cognac, Missouri, or Hungary.

Artisan Barrels now offers a wide array of Nomblot concrete fermentation, ageing, and storage wine tanks.

In 2009, Artisan Barrels introduces Lejeune from St. Emilion, specializing in variable capacity and truncated stainless tanks.

Rousseau offers both Traditional and Innovation Range barrels: Piano, Allegro, and Video barrels for 2010. Order Rousseau open-top fermentors, maturation tanks, and round/oval casks before Spring 2010.

Saint Martin offers 15 and 30-gallon French barrels for home winemakers, or winery split lots and/or topping wine needs, and a full range of standard and red wine fermentation barrels.

Allary, Rousseau, Saint Martin, and Balazs puncheons and hogsheads are recommended for wines requiring minimal oak extraction and gentle oak exchange.

Balazs barrels, built in Hungary with dependable craftsmanship, are distributed by Artisan Barrels in California, Oregon, and Washington (24/36-month wood available).

A&K Cooperage offers value-priced Missouri oak barrels with their Traditional barrel and the new longer and deeper BACCUS toast, premium finish barrel.

For more information, contact:
Artisan Barrels
Jérôme Aubin
6050 Colton Boulevard, Oakland, CA 94611
tel: 510/339-0170; fax: 510/339-0173
e-mail: jerome@artisanbarrels.com
website: www.artisanbarrels.com
PLEASE SEE ARTISAN BARRELS AD, PAGE 45.

Barrel Builders

Barrel Builders is the exclusive distributor for **Tonnellerie Marchive** barrels (France), **Kádár Hungary** barrels, and **East Bernstadt Cooperage** (EBC) barrels from Kentucky.

Kádár has been crafting 225L barrels in Hungary for more than 50 years, using wood exclusively from the Zemplen forest in the Carpathian Mountains. Long the pre-eminent cooperage in Central Europe, KH has become a mainstay of premium wine programs in wineries around the world.

Tonnellerie Marchive still uses a long, slow toasting process pioneered in Jarnac 60 years ago to produce premium oak barrels. Marchive is situated in the province of Bordeaux, between the vineyards of Medoc and Cognac, a short distance from some of the best French forests (Allier, Nevers, and Troncais).

East Bernstadt Cooperage (EBC) builds 60-gallon barrels for Barrel Builders from three-year air-dried *Quercus alba* sourced in the Daniel Boone National Forest in the heart of the Appalachian Mountains.

Barrel Builders offers a full range of French (*Quercus robur*) and American (*Quercus alba*) oak chips. Both are medium-size chips with a medium or medium-plus toast.

For more information, contact:
Barrel Builders, Inc.
PO Box 268, St. Helena, CA 94574
tel: 707/942-4291; fax: 707/942-5426
e-mail: Phil@barrelbuilders.com
website: www.barrelbuilders.com
PLEASE SEE BARREL BUILDERS AD, PAGE 32.

The Boswell Company

With 30 plus years of cooperage experience, **The Boswell Company** offers French, American, and Romanian oak barrels with personality and consistent quality. Artisan-level coopers operate with dedication and integrity. Doing business with the Boswell Company is economically attractive, easy, and pleasant.

In 2009, **Tonnellerie de MERCUREY** opened their new state-of-the-art facility. The ISO-9001, ISO-22000 and PEFC certified, Burgundy cooperage specializes in barrels for Pinot Noir, Chardonnay, and Syrah. All stave wood is split and seasoned at owner Nicolas Tarteret's mill in Champagne. Proprietary toasts combine with high-quality French oak for consistent barrels every vintage.

Tonnellerie BOSSUET is owned and operated by Jean-Louis and his family. Thin stave BOSSUET barrels have found success in Merlot, Cabernet Sauvignon, Cabernet Franc, and Sauvignon Blanc. Jean-Louis personally selects and sources quality French oak to be split and seasoned on premise in open-air chimneystacks. In the tonnellerie, master coopers build each BOSSUET barrel from start to finish.

Tonnellerie MARGO, an integrated stave mill and cooperage, specializes in three-year air-dried oak from the Carpathian mountains in Romania. The Vulturar family personally selects, splits and seasons the fine-grain oak. MARGO coopers build each barrel from start to finish in true old-world tradition.

For more information, contact:
The Boswell Company
1000 Fourth St., #640, San Rafael, CA 94901
tel: 415/457-3955; fax: 415/457-0304
website: www.boswellcompany.com
PLEASE SEE BOSWELL COMPANY AD, PAGE 66.

Bouchard Cooperages

Bouchard Cooperages is a global barrel brokerage company representing:

Damy (Meursault) and **Billon** (Beaune), collectively known as **Les Tonnelleries de Bourgogne**, who have provided barrels and puncheons to American producers of Chardonnay, Pinot Noir, and other fine wines for more than 20 years. Both cooperages specialize in French and Eastern European oak barrels and puncheons.

Vicard Tonnelleries (Cognac), a 100% family-owned and operated company, is ISO 9002-certified for barrel fabrication. The latest technology is incorporated with age-old tradition to control the heating process and produce barrels, puncheons, and tanks made from high-quality French, Eastern European, and American oak.

Tonnellerie Cadus (Ladoix-Serigny), a partnership formed by Maison Louis Jadot of Burgundy, Vicard Tonnelleries, and Vincent Bouchard to produce ultra-premium barrels. All Cadus staves are air-dried in Burgundy for at least 30 months.

BOUCHARD COOPERAGES

Laglasse (Varize) is a small family-owned French oak trading and processing company that produces high-end staves for some of the finest cooperages, including Tonnelleries Damy and Billon. Using a patented convection oven heating process, Laglasse now offers premium Tank Staves and Barrel Inserts made from the same "first-run" French oak that they use to make their barrel staves.

In partnership with the above coopers, **Bouchard Cooperages** invites customers to access the company's website, www.bouchardcooperages.com, which contains results of an analytical survey of barrels, a current price list, and other interesting information about the cooperage industry and these suppliers.

For more information contact:
Bouchard Cooperages
PO Box 60, Napa, CA 94559
tel: 707/257-3582, fax: 707/254-0852
e-mail: office@bouchardcooperages.com
website: www.bouchardcooperages.com

PLEASE SEE BOUCHARD COOPERAGES AD, PAGE 25.

Canton Cooperage

"American tradition, French know-how" describes the philosophy of barrel making at Canton Cooperage. As part of the Chene & Cie group (along with Taransaud and Kadar), Canton Cooperage combines the best of American and French coopering techniques in the production of premium American oak barrels.

Canton Cooperage (Lebanon, Kentucky) is in the heart of the Appalachian hardwood forest. Proximity to high-quality white oak allows Canton to select the very best wood. The climate of central Kentucky is ideal for open-air seasoning of the oak (origin and aging of all Canton oak is certified by the international certification agency Bureau Veritas).

CANTON

Barrel toasting, another key to quality coopering, is done according to time-tested French techniques, combined with the most modern temperature-control technology.

Winemakers may choose from two product lines of Canton Cooperage barrels. Canton's GRAND CRU barrel is made from fine grain, 36- or 48-month American oak and is notable for subtle sweetness and spice. The Canton VINTAGE barrel is made from American oak (air-dried for a minimum of 24 months), and features distinctive vanilla, caramel, and almond characters.

All Canton barrels are available in 225-, 228-, 265-, and 500-liter formats.

For more information, contact:
Canton Cooperage
5803 Skylane Blvd.#C Windsor, CA 95492
tel: 707/836-9742; fax: 707/836-9759
website: www.cantoncooperage.com

Heritage Barrels, LLC

Heritage Barrels offers American, French, and Eastern European oak products with a blend of French and American know-how to produce barrels of exceptional quality. The partners have over 150 years of combined experience in winemaking, vineyard management, wood sourcing, barrel making, and serving the wine industry. Heritage Barrels is the exclusive distributor for Tonnellerie Vallaurine, Giraud, Heritage Barrels American and "The Continental" fine wine barrels.

Vallaurine offers Rive Droite wood blend for wines with richness and complexity. Rive Gauche wood blend, with softer tannins, is ideal for wines of finesse and elegance.

Giraud barrels have 24- and 36-months of open-air seasoning. Gontran Beaudoin is a Bordeaux- and Cognac-trained enologist who oversees every step to ensure quality. Barrels from both French coopers are made from French oak, sourced from privately owned French forests.

Heritage Barrels American oak is air-dried for 36 months. *Quercus alba*, tight grain wood free of knots and sapwood, is sourced from Minnesota, Indiana, and Missouri.

HERITAGE BARRELS

"The Continental" is European oak primarily sourced from Hungary, air-dried for 24 months. All Heritage Barrels barrels are fire-bent over small oak fires in the traditional French methods, taking full advantage of the Maillard reaction products released in the toasting process.

For more information contact:
Heritage Barrels, LLC
John Schilter, Managing Partner/Winemaker
mobile: 707/696-7695
e-mail: john@heritagebarrels.com

PLEASE SEE HERITAGE BARRELS AD, PAGE 40.

J. Rettenmaier USA

For 130 years, J. Rettenmaier & Söhne has manufactured high quality wood and fiber products from native European forests. Best Oak Premium oak chips are a continuation of that legacy. Produced from certified sustainable French forests with the highest quality German manufacturing standards, Best Oak Premium oak chips have unmistakable aromatic and technical properties, compared with competitive products.

Only the highest quality aged French Oak is toasted by J. Rettenmaier & Söhne's convection method, to produce the most consistent chip size and toast levels on the market for repeatable performance year after year. Best Oak Premium oak chips are available in three chip sizes and three toast levels.

J. Rettenmaier & Söhne's newest innovation is Best Oak Dust-Free Powder — oak powder for harvest with up to 90% less dust and handling issues, compared to traditional oak powders.

J. RETTENMAIER USA LP

J. Rettenmaier & Söhne's commitment to winemaking led to the proprietary "Aroma Safe" protection concept. In addition to moisture and rot protection, the aroma remains the same as on the day of toasting, even after several months of storage. Best Oak Premium products are available in the USA and Canada from J. Rettenmaier USA, LP, www.jrsusa.com.

For more information, contact:
J. Rettenmaier USA LP
16369 US 131 Hwy, Schoolcraft, MI 19087
tel: 877/895-4099; fax: 269/679-2364
e-mail: info@jrsusa.com
website: www.jrsusa.com

PLEASE SEE J. RETTENMAIER AD, PAGE 61.

Knox Industries

Mel Knox represents two of the best cooperages in the world: Tonnellerie Taransaud and Tonnellerie Freres.

Tonnellerie Taransaud (Merpins, France) supplies many kinds of barrels to the greatest wine estates in the world. The Taransaud secret is twofold: excellent stock of naturally air-dried wood (all age-certified by Bureau Veritas), and great attention to detail. A thermocouple measures the temperature of barrels when toasting. Time and temperature are closely monitored, to prevent surprises.

Besides making 225L barrels, Taransaud offers 350L, 500L, and 600L barrels, plus tanks, round casks, and ovals. Taransaud also offers a Taransaud-Beaune 228L barrel.

In the past 10 years, Taransaud has installed many oak tanks, ovals, and round casks in Oregon and California, including 56 tanks for the To-Kalon Room at Robert Mondavi Winery, 12 tanks for Niebaum-Coppola, and many special tanks at Harlan Estate. Tanks at Harlan and Niebaum-Coppola/ Rubicon have stainless steel tops with a removable inner cap, ideal for fermentation and/or storage.

Tonnellerie Francois Freres is respected for its work with top Domaines in Burgundy, California, and the world. Both Burgundy and Bordeaux-shape barrels are available. In 1999, the Francois Freres group bought 50% interest in Trust International, a producer of Hungarian oak barrels. As the species of oak found in Hungary are the same as those in France, barrels resulting from this alliance have been of great interest to winemakers. The results of the Francois investment have been excellent, yet well-priced barrels that are allocated.

For more information, contact:
Knox Industries
Mel Knox
505 29th Ave., San Francisco, CA 94121
tel: 415/751-6306; fax: 415/221-5873
e-mail: mel@knoxbarrels.com
website: www.knoxbarrels.com

Nadalie USA/Tonnellerie Française

Nadalie USA offers American, French, and Hungarian oak products, with French know-how and heritage in the Napa Valley since 1980.

NADALIE
USA

From the tree to the barrel, Nadalie USA believes in a company tradition of mastering the whole manufacturing process, from tree selection to the final product. The company owns stave mills in the U.S. and France for all American and French oak products. Nadalie seasons woods at its mills for a minimum of two years.

Nadalie USA, in addition to providing fine barrels manufactured from American oak in California, offers world-recognized French oak barrels from Tonnellerie Nadalie in Bordeaux, France, and from Tonnellerie Marsannay, in Burgundy.

From the same trees as its barrels, Nadalie offers Oak Add Ins adjunct products. Nadalie is a master in this field with over 20 years' experience in adjunct cooperage products. Nadalie never compromises with quality, fire-toasting all Oak Add Ins products, which are chosen with the same rigorous oak tree selection as their barrels.

For more information, contact:
Nadalie, USA/Tonnellerie Française
1401 Tubbs Ln., Calistoga, CA 94515
tel: 707/942-9301, fax: 707/942-5037
e-mail: info@nadalie.com
website: www.nadalie-usa.com

PLEASE SEE NADALIE USA AD, PAGE 12.

Oak Solutions Group

Oak Solutions Group is a premium oak products company providing expert advice, niche products, and unparalleled selection.

ēvOAK, a line of forward-thinking oak products, sets the standard for oak alternatives by representing innovations in design, toasting, and packaging of the finest French and American oak.

New in 2009, ēnoCUBES are a combination of carefully selected oak cubes blended to bring out the greatest in each enological stage. ēnoCUBE selection includes white and red fermentation blends, aging blends, and finishing blends.

Also new this year, **trū/tan** gallo and ellagic-tannins are the result of ten years of research. Blends are created using oak directly sourced from the same premium forest regions as fine French oak barrels, blended into three formulas:

- **f² Fermentation Finishing** adds structure during fermentation, and freshness during finishing of red/white wines.
- **vf Vinification Formula** helps increase protein stabilization, improve structure, and protect wine from oxidation during aging.
- **rf Reserve Formula** balances the structure of reserve wines, accentuating toasted oak attributes, adding length and preserving varietal character.

All trū/tan blends are pure, 100% natural, in conformity with the Enological Codex, and dissolve easily.

ēvOAK and trū/tan are exclusively distributed by Oak Solutions Group. Sample kits available.

For more information, contact:
Oak Solutions Group
Paul Abbott, Oak Solutions Specialist
2557 Napa Valley Corp. Dr., Ste. D
Napa, CA 94558
tel: 707/259-4988; fax: 707/255-5952
e-mail: pabbott@oaksolutionsgroup.com
Kyle Sullivan, Oak Solutions Specialist
tel: 707/287-8555; fax: 707/255-5952
e-mail: ksullivan@oaksolutionsgroup.com
website: www.oaksolutionsgroup.com

Pickering Winery Supply

Pickering Winery Supply offers barrels from coopers in Bordeaux, Burgundy, and Pennsylvania.

Tonnellerie Doreau's initial success was with long-aging Bordeaux red wines, but the barrels' elegance and slow extractability have proven ideal for Chardonnay, Italian reds, or any wines that require a finely textured oak backbone for high-quality fruit. An unusual, untoasted barrel is the Selection Thierry Chauffe Blonde, a component barrel made with the finest-grain 3-year air-dried oak.

Tonnellerie Doreau

Tonnellerie Vernou's highly consistent barrels come in different profiles including "Burgundy Blend" with longer toast, "waterbent" for Sauvignon Blanc, or a hybrid with American staves and French heads. Vernou offers sizes from 20L barrels, to ovals and upright tanks up to 50,000 liters, and Roll Fermentors in 600L, 900L, or 1,200L. See Roll Fermentors at Tonnellerie-Vernou.com.

Highly regarded Burgundian cooper Tonnellerie Meyrieux toasts barrels over small braziers for 1.5 hours to achieve a distinctive, smoky, fruit-driven barrel for Burgundian varieties and Syrah. They offer 2-year and 3-year air-dried wood, and puncheons. Production is limited.

Keystone Cooperage has been making oak products for three generations. They know where to look for the best and oldest oaks to be transformed into the gentlest 60-gallon American oak barrels, exclusively made for wine.

For more information, contact:
Pickering Winery Supply
888 Post St., San Francisco, CA 94109
tel: 415/474-1588; fax: 415/474-1617
e-mail: pickering@sbcglobal.net
website: www.winerystuff.com

Premier Wine Cask

Premier Wine Cask is the exclusive North American representative for **Tonnellerie Dargaud & Jaeglé (D&J)** and **Marcel Cadet.** For three generations, D&J has crafted fine barrels for the top wineries in the world. Exhaustive wood selection and an unwavering commitment to traditional craftsmanship make the D&J barrel predictably elegant. Dargaud & Jaeglé's unique water-bending process conducts heat from an oak fire deeply into the wood to create a subtle and sophisticated spiciness, unmatched by any other barrel.

DARGAUD & JAEGLE
Tonnellerie

Premier Wine Cask is also the exclusive worldwide representative for **Barrel Associates International American Oak Collection**. With one or more of Barrel Associates' traditional innovative bending and toasting regimes (DeepToast™, Water Bent, Fire Bent), a wine gains luscious depth, complexity, and palate length.

BARREL ASSOCIATES

Premier Wine Cask is sole representative for **Innovative Rack System LLC**, and **BiBung**. Innovative Rack System is a unique steel core polypropylene deep cradle rack designed for safe and secure barrel stacking and moving. The BiBung is a one-of-a-kind barrel bung that provides a better barrier against oxidation and airborne haloanisole contaminants.

For more information, contact:
Premier Wine Cask, Inc.
tel: 800/227-5625
e-mail: info@premierwinecask.com
website: www.premierwinecask.com
PLEASE SEE PREMIER WINE CASK AD, PAGE 38.

Quality Wine Barrels

Quality Wine Barrels Company was founded in 2002 as Meza Barrels. Founders Roger Burson and Pedro Meza worked together at a large California winery, and saw a need for obtaining reliable, high quality, used wine barrels from sources they could trust. They started out part-time in the barrel business while managing a 40,000-barrel winery operation in Santa Maria, CA.

Quality Wine Barrels now sells tens of thousands of used French and American oak wine barrels, serving the needs of wineries and winemakers who pre-order barrels each year suited to their programs.

Quality Wine Barrels brokers only the finest used wine barrels that have undergone a rigorous five-point inspection (for cracked staves, internal flaws, off-odors, leakage, and VA), and are certified as suitable to be reused for wine storage and aging. Barrels are stored in a temperature and humidity-correct barrel warehouse in Santa Maria, where they are racked and carefully maintained, ready to fill.

Quality Wine Barrels also offers used wine racks, and buys used barrels.

Call or email Quality Wine Barrels to place a barrel and rack order for next harvest.

For more information, contact:
Quality Wine Barrels
1772 Tierra Nueva Ln, Oceano, CA 93445
tel: 805/925-9903
e-mail: sales@qualitybarrels.com
website: www.qualitywinebarrels.com

PLEASE SEE QUALITY WINE BARRELS AD, PAGE 48.

Saury U.S.A.

Tonnellerie Saury is a family owned cooperage with a generational history dating back to 1873. The cooperage is in Brive at the base of the Massif Centrale near the prime oak forests of France.

While the cooperage has set an industry standard with tight grain, Center of France oak, Saury also adapts to other variables given the needs and desires of the winemaker with an immersion barrel, "la Bourgogne" focused for Chardonnay and Pinot, and a traditional fire-bent for classic Bordeaux varieties, as well as American and Eastern European oak.

In response to customer demand for tanks, Saury produces conical upright tanks (10 HL to 150 HL) from a designated facility in Cognac. Please call for references and further information.

Saury, with one of the largest stave yards in the industry, provides the most consistent barrels available, and employs a multi-point TCA testing program unmatched among cooperages. Saury is proactive, and leads the fight against TCA and its related compounds. Saury is the only cooperage to be fully compliant with ISO 9001 and HACCP standards, with full traceability of the wood.

Contact Bayard, Christy or Adam for more information.

For more information, contact:
Saury U.S.A.
Bayard Fox, Christy Thomas, and **Adam Waisblatt**
PO Box 672, Rutherford, CA 94573
tel: 707/944-1330; fax: 707/944-1370
e-mail: info@sauryusa.com

PLEASE SEE SAURY USA AD, PAGE 14.

Skolnik Industries, Inc

Skolnik stainless steel cooperage is designed to meet the special needs of winemakers in all stages of fermentation, maturation, and storage of fine wines. Skolnik has a long and proud tradition of providing leading winemakers with stainless steel drums of high quality, durability, and design.

Skolnik's wine industry customers look to stainless steel cooperage to supplement oak barrels in key stages of the winemaking process. Stainless steel offers unique and unsurpassed qualities for preserving product integrity and purity — important considerations for why stainless is a key tool for winemakers.

Stainless steel cooperage is:

- Versatile and adaptable to many uses;
- Ready for use after being sterilized;
- Cost-effective and long-lasting;
- Predictable, reusable, and easy-to-clean;
- Virtually maintenance-free;
- Available in sizes from 5 to 55 gallons.

Skolnik is a full-service manufacturer of steel containers and accessories. Every Skolnik container is thicker, heavier, and stronger than industry standards — a commitment made to customers for more than 75 years.

SKOLNIK INDUSTRIES, INC.
MANUFACTURERS OF STAINLESS STEEL BARRELS

For more information, contact:
Skolnik Industries, Inc.
Jason Snow
4900 S Kilbourn Ave., Chicago, IL 60632
tel: 773/362-1913; fax: 773/735-7257
e-mail: jason@skolnik.com
website: www.skolnik.com

PLEASE SEE SKOLNIK INDUSTRIES AD, PAGE 61.

StaVin

All StaVin oak is naturally seasoned for a minimum of three years, and fire-toasted by traditional methods to deliver the nostalgic aromas and complex flavors commonly associated with barrels. StaVin supplies French, American, and Hungarian oak in medium, medium plus, and heavy toast levels.

StaVin introduces the new "Barrel Head" oak product. This slightly heated oak product, when blended with StaVin toasted products, will add richer mouthfeel and subtle nuances as tasted in only high-end barrels. The Barrel Head is the missing link for barrel alternatives, and the oak is also seasoned for at least three years in order to offer this type of product.

Savour oak uses long-cycle convection toasting seasoning protocol to deliver sweet aromatics and a viscous mouthfeel to wine. StaVin's Tank Stave Fan Packs deliver the same traditional flavors as barrels at a fraction of the cost. StaVin Oak Beans and Stave Segments are packaged in food-grade nylon bags for versatile, cost-effective, toasted oak infusion systems for tanks. The Barrel Replica, Traditional Barrel Insert, and Infusion Tube will revitalize neutral barrels, imparting the complexity and quality of a new barrel.

StaVin's website (www.stavin.com/research.htm) is a definitive resource outlining innovations in oak and oxygenation for winemaking.

For more information, contact:
StaVin
Alan Sullivan, Steve Sullivan, Dr. Jeff McCord, Dr. Jeff Murrell, Jamie Zank
PO Box 1693, Sausalito, CA. 94966-1693
tel: 415/331-7849; fax: 415/331-0516
e-mail: info@stavin.com
website: www.stavin.com

PLEASE SEE STAVIN AD, PAGE 53.

Tonnellerie Bel Air

Tonnellerie Bel Air's unique system of tasting oak, tree by tree, places Bel Air among the top tier of innovative, artisanal coopers. Located near Bordeaux, Tonnellerie Bel Air produces a range of competitively priced Bordeaux- and Burgundy-style barrels using 100% French oak.

Bel Air has developed a detailed monthly protocol of blind tasting stave wood during its aging period with a water infusion process, in order to assess variation in wood character, and, on a sensory level, the optimum aging time.

Once properly seasoned, stave wood is again tasted to define an oak profile and to categorize the wood, primarily according to its tannin structure, flavor characteristics, and the volume and texture it may offer a wine.

Barrels are customized for each client by focusing on the winemaker's desired results, and by understanding how oak may influence a wine's style. As a small operation, it is Bel Air's goal to define oak blends and toast levels to suit a wine's structure and customer's aims. Barrel consistency, from year to year, runs high through Tonnellerie Bel Air's dedication to the principles of its oak tasting method in tandem with the quality service offered to its customers. Details can be found at the cooperage's new website.

For more information, please contact:
Tonnellerie Bel Air
Arminée Chahbazian, U.S. representative
PO Box 444, Calistoga, CA 94515
tel: 707/987-8905; fax: 707/987-4629
e-mail: ac@arminee.com
website: www.tonnellerie-bel-air.fr

PLEASE SEE TONNELLERIE BEL-AIR AD, PAGE 23.

Tonnellerie Boutes

Family-owned Tonnellerie Boutes, run by Pierre and Eric Barthe, is one of the most highly renowned French cooperages. Headquartered near Bordeaux, it produces more than 30,000 barrels per year.

The company's Cooper Select, Selection, or Grande Reserve barrels, each with distinct aromatic profiles, are available in 225L and all styles. Boutes also offers American and European oak.

To obtain the best possible quality of oak, the cooperage's main source is the French National Forestry Office. Boutes has full mastery over the origin, preparation, and maturation of its wood, thereby fully guaranteeing quality and consistency. Staves are matured for 24 to 36 months in the open air at the Allier stave yards.

The real secret to barrel-making lies in the expertise of the master coopers; they are experts in controlling various toast levels to reveal the unique character of each cask, providing aromatic finesse and elegance, silky tannins, good length and volume on the palate, with the greatest respect for the fruit.

Boutes has the expertise to produce the highest quality tanks and large casks, in sizes from 10 to 100 HL. All are tailor-made with painstakingly selected wood that reaches a high level of maturity.

For more information, contact:
Tonnellerie Boutes
Manny Martinez
tel: 510/799-1518
e-mail: boutesusa@sbcglobal.net
website: www.boutes.com
Andy Gridley
tel: 707/363-7555
e-mail: usaboutes@yahoo.com

PLEASE SEE TONNELLERIE BOUTES AD, PAGE 16.

Tonnellerie Garonnaise

Tonnellerie Garonnaise, located in Marmande 90 kilometers southeast of Bordeaux, is a small cooperage where only the highest standards are employed. Founded about 20 years ago, the cooperage made its name mainly in the Bordeaux wine world, thanks to the mechanical, esthetic, and flavor qualities of its barrels, and through partnerships with key players in the wine industry.

Tonnellerie Garonnaise was purchased by Tonnellerie Boutes two years ago. The cooperage maintains old-world craftsmanship without neglecting the needs of modernity.

Each cask is fashioned as a unique piece, striving for perfection in terms of manufacturing and purity of aromatic profile. The master coopers have in-depth knowledge of wood and will guarantee respect of the rules of French coopering.

TONNELLERIE GARONNAISE

MARMANDE
FRANCE

From selection of the stave wood through to the highly specific toasting operation, Tonnellerie Garonnaise does its utmost to offer a stylish, unique "Expression" barrel. The Expression barrel is a blend of premium-quality oak stave wood which undergoes a very long, gradual, deep toast, resulting in slow thermo-degradation of the wood fibers, which results in seductive aromas and a rounded, silky texture; in short, a complex and rare final product.

For more information, contact:
Tonnellerie Garonnaise
Manny Martinez
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Andy Gridley
tel: 707/363-7555
e-mail: usaboutes@yahoo.com
website: www.garonnaise.com

PLEASE SEE TONNELLERIE GARONNAISE AD, PAGE 69.

Tonnellerie Leroi

Tonnellerie Leroi Barrels include: 225L Bordeaux Export, 238L Export thin stave (22mm) Chateau, and 228L Burgundy Export/Traditional. Hogsheads, puncheons, and wood tanks are also available.

Tonnellerie Leroi was founded in 1715 in Cognac, France — the oldest continuously operating cooperage in France (formerly Martell). Producer of premium, handcrafted Bordeaux and Burgundy-style artisan wine barrels, Tonnellerie Leroi provides exceptional barrels to North America and the world; almost 300 years after the first Leroi coopers were hired.

Using the very best fine grain oak from the forests of central France, Tonnellerie Leroi continues to make a full range of wine and spirits barrels from sustainable and traceable sourced oaks perfectly suited for fine wines.

The unique climate in the heart of Cognac assists in seasoning Leroi's carefully selected staves, creating integrated, finely textured flavors suitable for making balanced, consistent wines.

Twelve experienced artisan coopers handcraft each barrel with care to strict quality standards.

Each Leroi barrel has a unique barcode to provide the wood stave history, while also having a 99.99% TCA-free guarantee.

LEROI
TONNELLERIE

Tonnellerie Leroi has recently been awarded ISO 9001 and HACCP certification, and continues its pursuit for excellence in barrel production and customer service. Visa, MasterCard, and American Express payments accepted.

For more information, contact:
Tonnellerie Leroi
Michael Mercer
North American Sales Manager
PO Box 249, Healdsburg, CA 95448
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e-mail: info@leroibarrels.com
website: www.leroibarrels.com

PLEASE SEE TONNELLERIE LEROI AD, PAGE 72.

Tonnellerie Mercier

From forest to cellar, quality control is a priority. Mercier owns their own mill, which, combined with new buildings, and modern machinery, ensures consistent and repeatable quality. Each barrel is coded to certify wood, air-drying time, and all manufacturing details. When wineries ask for the same barrel as in the previous year, Mercier can deliver.

Master Cooper Frederic Mercier uses oak obtained exclusively from French forests that have proven to be consistent, continuous sources of premium oak. Available barrels include: 225L Bordeaux with 27mm or 22mm staves, Chateau Ferre, or the Tradition with chestnut hoops, and 228L Burgundy barrels in Export style, or Tradition.

The "Delicate" toast is available for Chardonnay and Pinot Noir. Mercier also offers 500L puncheons.

MERCIER

Mercier's team of experienced winemakers provides knowledgeable help to fine-tune barrel choices. Mercier experts can help winemakers create their favorite barrels, glass in hand, in the cellar.

For more information, contact:
Tonnellerie Mercier
Ken Deis
PO Box 606, Calistoga, CA 94515
tel/fax: 707/967-9645
mobile: 707/567-5711
e-mail: mercierbarrels@gmail.com

PLEASE SEE TONNELLERIE MERCIER AD, PAGE 20.

Tonnellerie Ô

Tonnellerie Ô handcrafts exquisite French oak barrels that are essential for the world's best wines. Superior quality stave wood is selectively sourced from the finest French oak forests, seasoned in the open air and rain of France, and coopered in California.

For 2009 and 2010, master cooper Jason Butler is building five traditional styles of **Tonnellerie Ô**® barrels. All are seasoned 30+ months and available in a range of house toast profiles, with or without toasted heads:

- Bordeaux Château Tradition
- Bordeaux Château Ferré
- Bordeaux Export Thin Stave
- Bordeaux Export
- Burgundy Export

To learn more about **Tonnellerie Ô**, or to inquire about scheduling a private tour of the cooperage, please call 707/752-6350 and ask for Ian Hartnett or Andrea Tary. Or visit the website: www.tonnellerieo.com.

Tonnellerie Ô

For more information, contact:
Tonnellerie Ô
Ian Harnett, Andrea Tary
531 Stone Rd, Benicia, CA 94510
tel: 707/752-6350; fax: 707/746-7471
e-mail: info@tonnellerieo.com
website: www.tonnellerieo.com

PLEASE SEE TONNELLERIE Ô AD, PAGE 36.

Tonnellerie Quintessence

Tonnellerie Quintessence intertwines cherished, centuries-old French tradition with modern technology, and defines the cooperage art. Located near St. Emilion just outside of Bordeaux, Tonnellerie Quintessence crafts barrels from the finest oak (*chêne français*), milled at France's most sophisticated PEFC-certified stave operation.

Tonnellerie
Quintessence
Bordeaux

Expert wood buyers take great care in wood selection, searching forests for straight, tight-grain oak. Master French coopers then craft a rare barrel that blends contemporary expertise with the style expected of a French cooperage. Working closely with each winemaker, Tonnellerie Quintessence creates barrels that complement and enhance the unique characteristics of the vintage.

This year, Tonnellerie Quintessence's stave mill in France renewed its PEFC and Bureau Veritas certifications to verify full traceability of all staves from date of production to shipment.

Tonnellerie Quintessence is the U.S. distributor for Heinrich Cooperage, based in the Barossa Valley, Australia. The 225L barriques and 300L barrels are ideal for winemakers wanting to make Australian-style Shiraz.

For more information, contact:
Tonnellerie Quintessence
Zach Thompson (Napa, Washington)
Elizabeth Van Emst (Sonoma, Oregon)
PO Box 1851, Sonoma, CA 95476
tel: 707/935-3452; fax: 707/935-3422
e-mail: contact@tonnelleriequintessence.com
website: www.tonnelleriequintessence.com

PLEASE SEE TONNELLERIE QUINTESSENCE AD, PAGE 26.

Tonnellerie Radoux USA

Radoux, one of the world's leading cooperages, manufactures French, American, and Eastern European oak barrels, tanks, puncheons, casks, chips, and insert-able staves in both France and the U.S.

The world of wine, along with the trend in consumer tastes, is constantly changing. Radoux cooperage has always worked closely with winemakers to apply the latest technology, techniques, and products to follow these changes and trends.

RADOUX

Oakscan™ is an important innovation in barrel making, based on near-infrared spectrometry. The Oakscan™ system for instant analysis, stave by stave, allows the precise measurement of tannin impact in the final wine from each barrel.

New products include Revelation — to meet the demand for maximum revelation of fruit in red wines; this new toast offers longer toasting at lower temperature and without "bousinage." X-Blend is a barrel developed to satisfy winemakers looking for an ultra premium barrel.

New certifications include PEFC: for sustainable French forest management, and Bureau Veritas to ensure the traceability and integrity of French oak barrels.

Radoux offers Pronektar oak alternatives: powder, granulate, chips, segments, barrel inserts, and tank staves, made from the same oak as the barrels and convection-toasted.

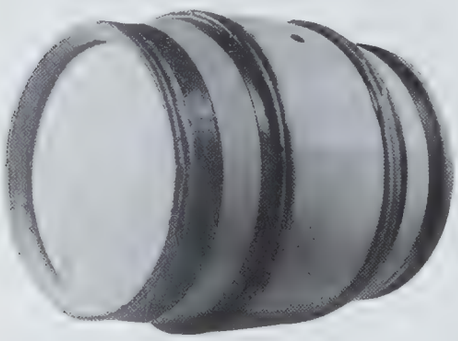
To discover which barrel suits your wine, visit the Made to Measure Barrel page at www.radoux.fr.

For more information contact:
Tonnellerie Radoux USA
480 Aviation Blvd., Santa Rosa, CA 95403
tel: 707/284-2888; fax: 707/284-2894
website: www.radouxcooperage.com

PLEASE SEE TONNELLERIE RADOUX USA AD, PAGE 34.

Tonnellerie Sirugue

Tonnellerie Sirugue is a family cooperage established in 1903 in Nuits Saint Georges, Burgundy. Sirugue barrels were among the first French oak barrels to be imported to the U.S. for fine wine ageing in the 1950s and 1960s.



Today, Sirugue focuses on wood selection, which is the basis of the cooperage's tasty barrels. Sirugue's wood is selected exclusively from French oak forests in the Allier, Nevers, Chatillon, and Vosges regions. The staves are naturally air-dried in Burgundy for a 24-month minimum. A 36-month, air-dried program is also available.

Sirugue produces Burgundy Traditional, Burgundy Export (228L), Bordeaux Export barrels (225L), hogshead (300L), and feuillettes (114L).

Aside from its traditional house-toast, Sirugue has worked intensively to achieve different toasting levels tailored to each customer's individual needs and style demands.

Sirugue's goal is a seamless integration of fruit and oak. The barrels can be sweet, spicy, subtle, and elegant; they enhance a wine's fruit characters and flavors; they lift the fruit, frame it, and make a star out of it.

For more information, contact:
Tonnellerie Sirugue
Francoise Gouges
2343 33rd St., Santa Monica, CA 90405
cell: 310/403-8398; fax: 310/988-2835
e-mail: francoise@sirugueusa.com

PLEASE SEE TONNELLERIE SIRUGUE AD, PAGE 18.

T.W. Boswell

Experienced master coopers have developed the T.W. Boswell collection of premium oak barrels, crafted from hand-selected wood. Each barrel has a distinct personality created for reserve-style wines.

Appellation Series: the Côte d'Or barrel provides traditional Burgundian toastiness while encouraging fruit expression. The Côtes du Rhône is best suited for Rhône varietals or blends. The Médoc barrel is made for more concentrated wines that benefit from extended aging. The Appellation Series is crafted with premium French oak produced at the cooperage's PEFC and Bureau Veritas-certified stave mill.

T.W. Boswell also crafts the Legacy barrel, which adds texture and maintains a proper balance of fruit and oak. The water-immersed **Eau** barrel adds a supple and elegant texture to the palate. Legacy and Eau barrels are available in French and American oak.

T. W. Boswell
POLONYI

A new addition to the T.W. Boswell collection is the Boswell **Polonyi** barrel, which embodies the finest efforts of the T.W. Boswell and Július Polonyi families. Each year, the Polonyi family harvests fine-grain oak from Slovakian forests and carefully mills it to the highest standards. The Boswell family then applies four generations of coopering expertise to this high-quality wood source. This barrel is available in Rouge and Blanc toasting styles.

T.W. Boswell is presented by Cooperages 1912.

For more information, contact:
T.W. Boswell
Jason Stout, Yuri DeLeon, Jerry DeLorenzo, Gary Kroll
2557 Napa Valley Corporate Dr. Ste. D,
Napa, CA 94558
tel: 707/255-5900; fax: 707/255-5952
e-mail: info@twboswell.com
website: www.twboswell.com

PLEASE SEE TW BOSWELL AD, PAGE 2.

VinOak USA

VinOak USA offers a wide range of premium oak barrels and alternatives to suit any style wine. All oak products are expertly supported by a specialized oak sales and service team, and a technical in-house oak R&D laboratory led by flavor chemistry specialist, Dr. Carlos Macku.

VinOak® Alternatives are crafted from premium French oak barrel stave wood selectively sourced by forest origin and grain from top French stave mills. Seasoned in France, then cut and toasted locally in California, VinOak Alternatives are available in both fire and convection house toasts in a variety of styles:

- Stave Sets
  - Tank Staves
  - Fan Packs
  - Barrel Inserts (through-the-bung)
  - Barrel Replicas (through-the-head)
- Rectangles
- Cubes

VinOak's outstanding barrel collection includes California-coopered American oak Burgundy Export and Bordeaux Export barrels in a range of fire and convection toast profiles. VinOak also offer Tonelería Quercus™ French and American oak barrels, created in Spain's Rioja region using TRH® — a patented radiant toasting technique to control profile consistency and customization.

To learn more about VinOak USA's fine collection of oak barrels and premium oak alternatives, please call 707/746-5704 and speak with Ian Hartnett or Andrea Tary, or visit the website: www.vinoak.com.

VinOak

For more information, contact:
VinOak USA
Ian Harnett, Andrea Tary
531 Stone Rd, Benicia, CA 94510
tel: 707/746-5704; fax: 707/746-7471
e-mail: vou@vinoak.com
website: www.vinoak.com

WineOAK, LLC

WineOAK is dedicated to providing high quality, consistent oak barrel alternatives to help craft exceptional wines. The founders have more than 60 years of combined experience in the production of oak barrels, and use this knowledge to source oak alternatives to meet winemakers' expectations: consistency, a range of flavor profiles, a variety of toasting methods, competitive pricing, on-time delivery and exceptional service.

WineOAK LLC

The WineOAK portfolio includes both American and French Oak:

- Tank inserts and fan systems;
- Barrel inserts — permanent inserts with installation and barrel chains;
- Oak chips — large, small (screened and unscreened), and powder;
- Oak cubes and segments.

WineOAK has a distinctive "House Profile" line of products. The House Profiles are offered in a variety of toasting methods that can be used independently, or combined within individual tank inserts, barrel inserts, cubes, and segments. This allows the winemaker more creative flexibility to put together a unique custom blend specific to winemaking requirements.

For more information, contact:
WineOAK, LLC
Rebecca McFall
tel: 707/363-7793; fax: 707/307-7272
e-mail: Rebecca@wineoak.com
website: www.wineoak.com

PLEASE SEE WINEOAK AD, PAGE 55.

World Cooperage
Cooperages 1912 Napa

World Cooperage is an industry-leading cooperage providing consistent quality and value through innovation. Proudly crafting oak barrels using its Barrel Profiling technology, World Cooperage offers diverse, definable flavor profiles that are repeatable barrel-to-barrel and vintage-to-vintage.

New in 2009 is an interactive barrel profiler at worldcooperage.com. This online system allows winemakers to explore profiles according to their wine and desired wood source in order to find the flavors that best fit their barrel program.

Founded in 1912, World Cooperage is a fourth-generation, family-owned cooperage. The World Cooperage team collaborates with winemakers through science research and sensory descriptive analysis to ensure the best pairing between wine and barrel.

World Cooperage is presented by Cooperages 1912.

World Cooperage

For more information, contact
World Cooperage
Cooperages 1912 Napa
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Napa, CA 94558
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e-mail: info@worldcooperage.com
website: www.worldcooperage.com

PLEASE SEE WORLD COOPERAGE AD, PAGE 7.

XTRAOAK

For more than 30 years, XTRAOAK has been providing the wine industry with the highest quality American and French oak alternatives.

XTRAOAK offers three products for oak renewal in barrels: a barrel insert unit, Oak on a Rope, and Xoakers; and four products for oak treatment in tanks: fan assemblies, stavettes, oak chips, and granular oak.

"XTRAOAK Light" American toast is characterized by the fresh sweetness of new-cut oak, butter, coconut, cream, and light vanilla.

"XTRAOAK Medium" American is a complex array of vanilla, rich cream, marshmallow, roasted nut, and spice.

"XTRAOAK Medium+" American is a dark-roasted American oak which maintains a wonderful sweetness, while also contributing caramelized and roasted characters.

"XTRAOAK Light" French is delicate and bright, featuring light vanilla, cedar, tea, and mineral notes.

"XTRAOAK Medium" French contributes the sweetness of fresh vanilla and cola, overlaying an exotic blend of brown spice, cedar, and tobacco.

"XTRAOAK Medium+" French features notes of burnt cream, mocha, graham cracker, spice, and black tea.

XTRAOAK

XTRAOAK oak is naturally seasoned and carefully toasted, employing time-tested techniques. All XTRAOAK products are now HACCP-certified for food safety by the internationally recognized Bureau Veritas certification agency.

For more information contact:
XTRAOAK
5803 Skylane Blvd. Ste. C
Windsor, CA 95492
tel: 707/836-9742; fax: 707/836-9759
website: www.xtraoak.com

PLEASE SEE XTRAOAK AD, PAGE 31.

SMART VITICULTURE *by Dr. Richard Smart*

Mark Kliewer honored at International Symposium

International viticultural researchers and grape and wine producers from the American wine sector attended a grapevine canopy management symposium at the University of California, Davis (UC Davis) on July 16, 2009. This symposium was dedicated to Professor Emeritus Mark Kliewer of UC Davis, who was a staff member there for more than 30 years and a pioneer in grapevine canopy management research in California.

Professor Kliewer organized the first international symposium on grapevine canopy management held in California in August 1986, attended by more than 500 people. Many of the speakers at that first symposium contributed to the second symposium 23 years later.

During his career, Kliewer made significant contributions to the California wine industry through his research on canopy management. Many of the present-day grape production systems can be traced to his research. He trained more than 50 graduate students, who are a continuing testament to his enthusiasm for viticultural research.

This symposium was organized by Dr. Nick Dokoozlian, one of Kliewer's former graduate students and currently Vice President of Viticulture for E&J Gallo Winery, Modesto, CA, and Jim Wolpert of the Department of Viticulture & Enology, UC Davis.

"It is difficult for me to imagine a viticulturist that has had a more profound impact on modern California grape production than Dr. Kliewer, Professor Emeritus at UC Davis," says Dokoozlian. "Kliewer trained a generation of viticulturists that currently influences grape and wine production in every major growing region in the world.

"A prolific researcher, he also laid the foundation of knowledge necessary to establish many of the standard vineyard development and cultural practices used today, including nitrogen and potassium fertilization, irrigation, vine spacing, training/trellising systems, and canopy management. It is nearly impossible to visit a vineyard today, in California or many other parts of the world, which has not been directly influenced by Kliewer's work.

"As a young graduate student, I found working alongside Kliewer in the vineyard quite challenging. He always volunteered for the most physically demanding job during harvest, and worked both quickly and methodically. His office door was always open to students and others requesting his assistance and advice. Hard working, dedicated, kind, and humble, Kliewer's scientific accomplishments were overshadowed only by his outstanding personal character. It was a great privilege to study and work under his guidance, and I am very proud to call Mark Kliewer my mentor and friend."

Dr. Pat Bowen (Canadian viticultural scientist and a former Kliewer student), began the symposium, reviewing Kliewer's research contribution. Interestingly, his early work was in temperature-controlled growth cabinets where he showed the significance of light and temperature in the formation of organic and amino acids, sugars, and anthocyanins.

By the 1980s, research conducted by Dr. Nelson Shaulis (Cornell University, Geneva, NY), in the eastern U.S. and European and Australian researchers demonstrated that the light and temperature environment of grape berries and leaves have an important impact on fruit composition and wine quality. This began a new period of research activity for Kliewer and his students, investigating aspects of vine physiology and canopy management in California.

Over the intervening years since the first symposium, the science has improved considerably. Dr. Hans Schultz, (Director of the Geisenheim Research Institute, Geisenheim, Germany), and also a graduate of UC Davis, presented results obtained from computer modelling of grapevine canopies. Using this approach, grapevine physiology can be simulated with a computer, allowing for evaluation of a wide range of inputs like climate and canopy architecture.

An Australian perspective on canopy management was presented by Dr. Peter Clingeleffer (CSIRO Plant Industry, Merbein, Victoria, Australia) who emphasized the important contributions of vineyard mechanization and minimal pruning.

Dr. Alan Lakso (professor and researcher at Cornell University's Geneva Experiment Station) was also a Kliewer graduate student. He presented intriguing results, showing the impact of the link between shoot growth rates and canopy microclimate on the concentration of methoxypyrazines in Cabernet Franc grapes in upstate New York.

Excessive green characters (sometimes called "veggie") are common in cool, wet climates like New York. It has long been known that fruit shading contributes to such undesirable character, but research by Lakso and his colleagues has shown that actively growing shoots in late July also contribute to these negative characters in grapes and wine.

Dr. Alain Carbonneau (Professor of Viticulture of Montpellier [France] SupAgro, and current president of GiESCO [Group of International Experts of Vitivinicultural

Today, Mark Kliewer has a ten-acre vineyard in the southern Willamette Valley [near Junction City] planted to: ⅔ Pinot Gris, ⅓ Pinot Noir, and one acre of Pinot Blanc. More than 90% of the grapes are sold to King Estate Winery, and the Pinot Blanc to Silvan Ridge Winery.

Systems for CoOperation]) presented a description of grapevine trellis systems in use around the world and showed how the wide range of grapevine canopy types can be analyzed and modeled. In particular, a few simple measurements can tell much about how vineyards will perform.

Dokoozlian reviewed the last 20 years of canopy management practices in California, including trellising and variation in tractor row and vine spacing. Contrary to popular opinion, he reported that research has shown that decreasing spacing in the vine row creates greater canopy density, an effect greater than inter-vine competition. Other studies show that narrow tractor rows, a practice often proposed for the purpose of improving wine quality, also lead to increased yield.

Dokoozlian emphasized how vigor manipulation by irrigation management has become an important component of canopy management. He noted the biggest change in canopy management in California in the last 20 years has been the adoption of the vertical shoot positioned (VSP) system. VSP is best suited for low- to moderate-vigor situations, but unfortunately, it is also used in high vigor situations.

Leaf removal in the fruit zone has now become widespread, and that improving fruit exposure with this practice helps reduce botrytis bunch rot. Regrettably, it is often done excessively, which is a particular problem in warm to hot growing regions, where excessive exposure is enhanced by leaf removal in north-south oriented rows.

Italian researchers Dr. Stefano Poni (Istituto di Frutti-Viticoltura, Universita Cattolica del Sacre Cuore, Piacenza), and Dr. Cesare Intrieri (Department di Colture Arboree, University of Bologna), presented another aspect of leaf removal. They have shown that removal of mature leaves before bloom reduces fruit set and so produces loose clusters (less prone to bunch rot). Because of regrowth of leaves by the vine and reduced yield, the improved ratio of leaf-area to fruit-weight leads to improved wine quality. The Italians have also taken advantage of Advantis vineyard mechanization, which requires less than 20 hours labor input per acre.

It was my pleasure to present the final paper, a particular honor since I was one of the speakers at the 1986 symposium. I went back some 130 million years to when flowering plants appeared in the Cretaceous period. One of 300 plant families that have subsequently been classified is Vitaceae, which contains *Vitis vinifera*, the European grapevine.

Many scientific members of the audience were surprised to learn that Charles Darwin, the founder of evolutionary theory, was a viticultural scientist. Darwin studied grapevines and other climbing plants in his glasshouse, which survives to this day at Down house near London.

Darwin was intrigued by the grapevine, particularly by the fact that opposite the leaf may exist a tendril or an inflorescence (which subsequently will become a grape

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Cost: $1,500/person - includes program, breakfast and lunch daily with accommodations at Embassy Suites Hotel, Sunday-Tuesday night.
OR $1,200 per person includes program with lunch only each day.

Discounts available to those who register by December 18, 2009.

OPTIONAL VINEYARD TOUR

On Thursday, there will be an optional tour for those who would like to visit area vineyards utilizing our testing and fertilization program. Soil tests of initial fertility levels and current changes will be shown. This provides an opportunity to see and ask questions of growers and their use of this program. Tour from 8:30AM to 4:00PM.
Cost: $150 includes lunch plus AM/PM breaks.

CONTACT: Kinsey Agricultural Services, Inc.
Tel: 573/683-3880 or 683-4800, or www.kinseyag.com

cluster) or some intermediate form. Darwin wrote in 1865 *"that these cases illustrate in a striking manner the principle of the gradual evolution of species."*

Canopy management researchers are well aware that the grapevine is in a "fruiting mode" in a well-illuminated canopy, which is also important for wine quality. I made the point that, unfortunately, canopy management research is now not very fashionable, despite the substantial gains in yield and wine quality that are possible. Viticultural research topics like molecular biology and precision viticulture are much more popular today than canopy management.

I noted the commercial success of companies using my canopy management advice, in particular Pago Vallegarcia in Spain and Fortress Vineyards in Lake County, California. Both companies have improved profitability from increased yields and/or wine quality.

I regret that canopy management techniques are not more widely applied in commercial vineyards, especially in my home country of Australia. Because of research efforts by Kliewer and others, the adoption rate and awareness in the U.S., and particularly California, is much higher.

The symposium presented important research about the state of canopy management today, but will there ever be another canopy management seminar? I doubt it. Like many other fashions in the wine business, canopy management may have passed its "Golden Years." ■

Dr. Richard Smart, "the flying vine-doctor," is an international viticultural consultant based in Launceston, Tasmania, in Australia. He can be contacted by e-mail: vinedoc@bigpond.net.au. Read about Dr. Smart's business, including his consulting schedule, educational wine tours, and seminars, at his home page www.smartvit.com.au. Contact him for consultations.

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Rally® fungicide registered for canker diseases in grapes

Dow AgroSciences has received registration from the U.S. EPA and California Department of Pesticide Regulation for Rally® fungicide to aid in control of grapevine canker diseases.

Rally® is applied to pruning wounds with vineyard sprayers immediately after pruning, helping to manage fungal pathogens which infect woody tissue, including various *Botrysphaeria* species and others. The Special Local Need label is for use in California only.

"Ongoing research by UC Davis has shown that double pruning followed by immediate application of Rally® can help prevent infection by fungi that cause these canker diseases," says Jim Mueller, Dow AgroSciences field scientist.

"Rally® can be applied with standard vineyard sprayers by capping certain nozzles so that the fungicide is directed toward pruning wounds.

"Growers could simply remove infected wood. But it is best to also protect the pruning wounds."

The application rate of the fungicide varies from 4 to 6 oz per acre, depending on spray volume (gpa) that a grower uses; see label for rates.

Wood diseases, caused by at least 14 fungal species, have been found throughout grape-growing regions of California and the world, infecting all major varieties. Researchers estimate overall loss in grower net income due to these diseases at $260 million per year in California alone. Those costs come in the form of reduced yields, loss of fruiting wood, vine retraining, and replanting.

Rally® should be applied within 24 hours after pruning, as pruning wounds are the primary route of infection.

"Depending on conditions, pruning wounds can take several weeks to heal and are susceptible until healed," Mueller adds. "The fungicide will provide at least two weeks of protection. If wounds have not healed by then, another Rally® treatment can be applied. That is especially important if rain is expected. Just ¼-inch of rain would release additional spores into the air and provide the conditions needed for spore germination and infection."

When possible, final pruning should occur in late winter. At that time, pruning wounds tend to heal faster and disease pressure tends to be less as spore sacks become depleted from winter rains.

UC Davis researchers found a late winter application of Rally® can reduce powdery mildew similar to a lime sulfur and oil treatment applied at that time. ■

[For more information, contact: Jim Mueller, Dow AgroSciences field scientist, 925/634-8768, jpmueller@dow.com.]

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Oak chips or tannins

Continued from page 39

findings which were independently verified by winemakers in a blind tasting.

This trial also indicates the need for an appropriate period of evaluation of such wine parameters, given the observed changes over the 14-month trial period.

The advantages offered by exogenous fermentation tannins like VR Supra and VR Color are observable in the real world, as evidenced by independent winemaker evaluation. ■

Dr. Paul Bowyer is an Adjunct Lecturer in Oenology, School of Agriculture, Food and Wine, Faculty of Sciences, The University of Adelaide, and the Technical Manager for LAFFORT Australia. He provides technical information and advice to the wine industry in the Australasian region. He can be contacted at paul.bowyer@laffort.com. LAFFORT is a supplier of enological tannins and oak chips.

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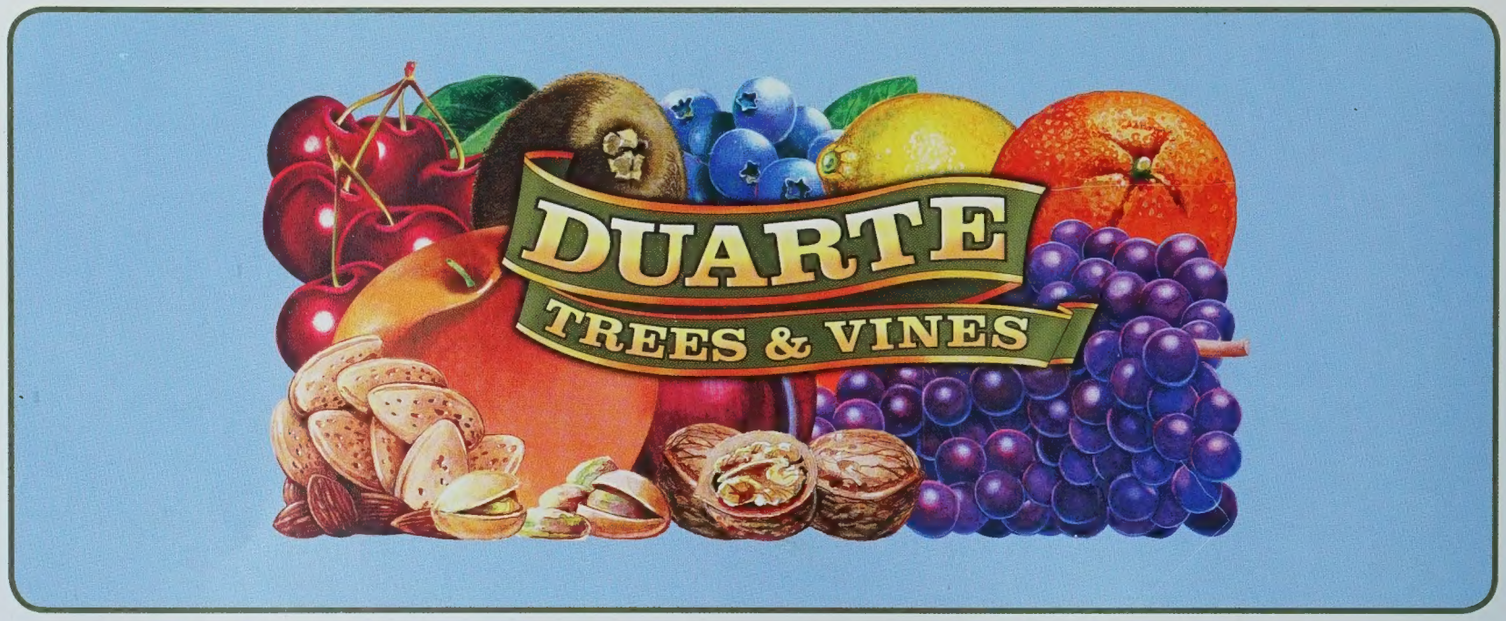

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